

Doc 9756  
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# Manual of Aircraft Accident and Incident Investigation

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## Part I Organization and Planning

Approved by the Secretary General  
and published under his authority

First Edition — 2000

International Civil Aviation Organization

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## AMENDMENTS

The issue of amendments is announced regularly in the *ICAO Journal* and in the monthly *Supplement to the Catalogue of ICAO Publications and Audio-visual Training Aids*, which holders of this publication should consult. The space below is provided to keep a record of such amendments.

## RECORD OF AMENDMENTS AND CORRIGENDA

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## FOREWORD

The purpose of this manual is to encourage the uniform application of the Standards and Recommended Practices contained in Annex 13 and to provide information and guidance to States on the procedures, practices and techniques that can be used in aircraft accident investigations. Since accident investigations vary in complexity, a document of this kind cannot cover all eventualities. The more common techniques and processes, however, have been included. Although this manual will be of use to experienced and inexperienced investigators alike, it is **not** a substitute for investigation training and experience.

This manual will be issued in four separate parts as follows:

Part I — Organization and Planning;

Part II — Procedures and Checklists;

Part III — Investigation;

Part IV — Reporting.

Because this manual deals with both accident and incident investigations and, for reasons of brevity, the terms “accidents” and “accident investigation”, as used herein, apply equally to “incidents” and “incident investigation”.

The following ICAO documents provide additional information and guidance material on related subjects:

- Annex 13 — *Aircraft Accident and Incident Investigation*;
- *Accident/Incident Reporting Manual (ADREP Manual)* (Doc 9156);
- *Accident Prevention Manual* (Doc 9422);
- *Manual of Civil Aviation Medicine* (Doc 8984);
- *Human Factors Training Manual* (Doc 9683);
- *Human Factors Digest No. 7 — Investigation of Human Factors in Accidents and Incidents* (Circ. 240).

This manual, which supersedes Doc 6920 in its entirety, will be amended periodically as new investigation techniques are developed and new information becomes available.

Readers are invited to submit material for possible inclusion in subsequent editions of this manual. This material should be addressed to:

The Secretary General  
International Civil Aviation Organization  
999 University Street  
Montréal, Quebec  
Canada H3C 5H7



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# **Chapter 1**

## **THE OBJECTIVE OF AN AIRCRAFT ACCIDENT INVESTIGATION**

1.1 Annex 13 defines the sole objective of an aircraft accident or incident investigation as the prevention of future accidents and incidents. It also states that it is not the purpose of an investigation to apportion blame or liability. Any judicial or administrative proceedings to apportion blame or liability should be separate from any investigation conducted under the provisions of Annex 13. Thus, the emphasis of an aircraft accident or incident investigation is on remedial actions.

1.2 An aircraft accident provides evidence of hazards or deficiencies within the aviation system. A well-conducted investigation should therefore identify all immediate and underlying systemic causes of an accident and recommend appropriate safety actions aimed at avoiding the hazards or eliminating the deficiencies. The

investigation may also reveal other hazards or deficiencies within the aviation system not directly connected with the causes of the accident. Thus, a properly conducted accident investigation is an important method of accident prevention.

1.3 An investigation should also determine the facts, conditions and circumstances pertaining to the survival or non-survival of the occupants of the aircraft. Recommendations for improvements to the crashworthiness of the aircraft are aimed at preventing or minimizing injuries to aircraft occupants in future accidents.

1.4 The Final Report, which is produced at the completion of an investigation, constitutes the official conclusions and record of the accident.

## **Chapter 2**

# **THE ACCIDENT INVESTIGATION AUTHORITY**

### **2.1 STRUCTURE**

2.1.1 In conformity with Article 26 of the Convention on International Civil Aviation, it is incumbent on the State in which an aircraft accident occurs to institute an inquiry into the circumstances of the accident. This obligation can only be met when appropriate legislation on aircraft accident investigation is in place. Such legislation must establish an accident investigation authority (or commission, board or other body) for the investigation of aircraft accidents.

2.1.2 The accident investigation authority must be strictly objective and totally impartial and must also be perceived to be so. It should be established in such a way that it can withstand political or other interference or pressure. Many States have achieved this objective by setting up their accident investigation authority as an independent statutory body or by establishing an accident investigation organization that is separate from the civil aviation administration. In these States, the accident investigation authority reports direct to Congress, Parliament or a ministerial level of government (see Figure I-2-1).

2.1.3 In many States it may not be practical to establish a permanent accident investigation authority. These States generally appoint a separate accident investigation commission for each major accident to be investigated, the members of which are often seconded from the civil aviation administration. It is essential that such a commission report direct to a ministerial level of government so that the findings and safety recommendations of the investigation are not diluted during passage through regular administrative channels.

2.1.4 Seconded experts are responsible to the investigator-in-charge for the duration of an investigation. This is not an ideal arrangement, however, since seconded personnel may fear retribution when they return to their normal duties should the civil aviation administration react unfavourably to the findings in the Final Report of the investigation. States should take steps to alleviate any possibility of retribution.

2.1.5 The accident investigation authority is required to determine the causes of an accident and to make safety recommendations. However, responsibility for the implementation of safety recommendations should rest with the civil aviation administration. This division of responsibility is appropriate since the civil aviation administration has overall responsibility for the regulatory framework of aviation and its development.

2.1.6 ICAO encourages States to foster regional aviation safety groups. Regional arrangements may include aircraft accident investigation matters, such as the delegation of investigations or parts thereof or enlisting the mutual assistance and cooperation of States in an investigation.

### **2.2 LEGISLATION**

2.2.1 Appropriate legislation that defines the rights and responsibilities of the aircraft accident investigation authority is required. The accident investigation authority should, through legislation, have immediate and unrestricted access to all relevant evidence without requiring prior consent from judicial bodies or other authorities. Accident investigators should be aware that aircraft accidents may be subject not only to technical investigation but also to some form of judicial inquiry. However, accident investigation procedures should not be constrained by judicial processes, and national legislation and regulations should specify the procedures to be followed in order to keep the technical investigation separate from judicial or administrative proceedings. The legislation should make it clear that accident prevention is the sole objective of the investigation and should emphasize that it is not the role of the accident investigation authority to apportion blame or liability.

2.2.2 The legislation may also protect certain documents and information obtained in the course of an investigation from public disclosure. To provide further safeguards in this respect, Annex 13, Chapter 5, states that the following records shall not be made available for purposes other than accident or incident investigation,



unless the appropriate authority for the administration of justice in the State conducting the investigation determines that the benefits of their disclosure outweigh the adverse domestic and international impact such action may have on that or any future investigations:

- cockpit voice recordings and transcripts from such recordings;
- all communications between persons having been involved in the operation of the aircraft;
- all statements taken from persons by the investigation authorities in the course of their investigation;
- medical or private information regarding persons involved in the accident or incident; and
- opinions expressed in the analysis of information.

These records shall be included in the Final Report or its appendices only when pertinent to the analysis of the accident or incident, and those parts of the records not relevant to the analysis shall not be disclosed. This is essential since information contained in these records, which includes information given voluntarily by persons interviewed during the investigation, could be utilized inappropriately for subsequent disciplinary, civil, administrative and criminal proceedings. If such were the case, people would, in future, be reluctant to openly disclose information to investigators, which would impede the investigation process and seriously affect flight safety.

## 2.3 FUNDING

The accident investigation authority should have ready access to sufficient funds to enable it to properly investigate those accidents and incidents which fall within its area of responsibility. Since it is impossible to accurately forecast annual budget requirements for accident investigation, provision should be made for supplementary funding as required.

## 2.4 PERSONNEL

2.4.1 Aircraft accident investigation is a specialized task, which should only be undertaken by qualified investigators. However, many States will not have personnel

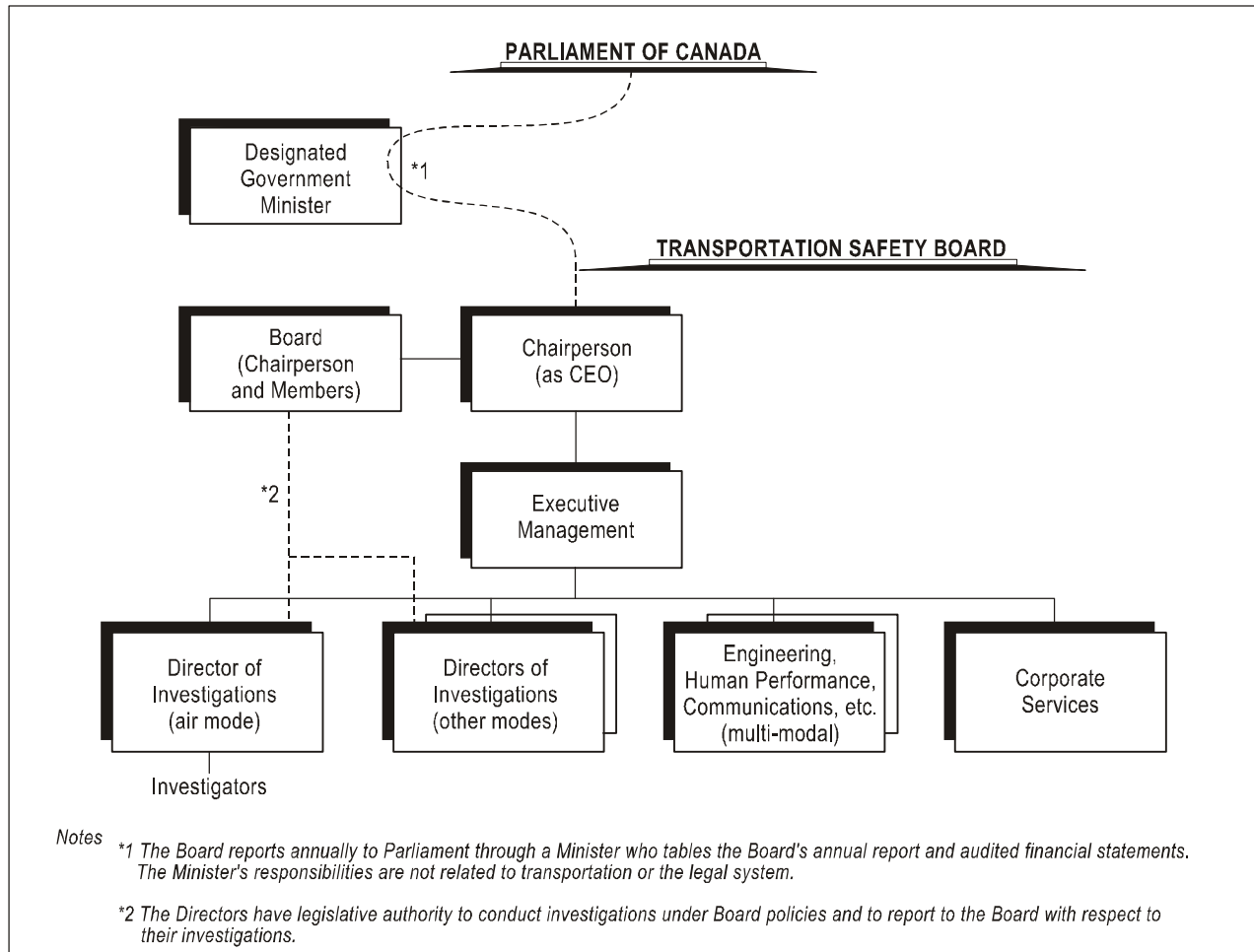
dedicated solely to accident investigation. In these States, appropriately qualified personnel should be identified and trained in accident investigation techniques prior to being assigned to accident investigation duties. When assigned to an accident investigation, such personnel should be relieved of their regular duties.

2.4.2 The investigation of an aircraft accident is a daunting task that is almost unlimited in scope. The more often investigators participate in investigations, the more experienced they become. As they gain experience, they soon realize that the need to increase their knowledge and upgrade their skills is never-ending. While training is essential, improvement in an investigator's capabilities generally results from a personal commitment to excellence. Since the outcome of an accident investigation is largely dependent on the skill and experience of the investigators assigned to it, at least one experienced investigator should be assigned to each investigation to ensure an adequate level of experience.

2.4.3 It is essential that accident investigators have a practical background in aviation as a foundation on which to develop investigation skills. This experience can be acquired by working as a professional pilot, as an aeronautical engineer or as an aircraft maintenance engineer. Other specialized areas of aviation which could also provide useful experience include management, operations, airworthiness, air traffic services, meteorology and human factors. Since accident investigations will often involve all of these specialized areas, it is important that investigators understand the aviation infrastructure and are able to relate to each of these different areas. It is also beneficial for investigators to have some piloting experience in addition to their other expertise.

2.4.4 In addition to technical skills, an accident investigator requires certain personal attributes. These include integrity and impartiality in the recording of facts, logic and perseverance in pursuing inquiries, often under difficult or trying conditions, and tact in dealing with a wide range of people who have been involved in the traumatic experience of an aircraft accident.

2.4.5 To effectively discharge their duties, accident investigators should be granted suitable statutory powers, including authority over an accident site, possession of evidence, the right to test anything seized and the right to obtain relevant documents. These powers should, however, only be used when necessary and with the utmost discretion. Investigators should realize that during the initial part of an investigation their task is essentially one of gathering information which is best undertaken in an atmosphere of cooperation.



**Figure I-2-1. Structure of the Transportation Safety Board of Canada**

2.4.6 Some persons may be reluctant to cooperate with the investigation because of a natural desire not to become involved. Often this resistance will disappear when it is explained that their assistance may help to eliminate similar accidents in future. An investigator relies extensively on other people as a source of information and, thus, should be able to relate well to people in any situation.

## 2.5 EQUIPMENT

2.5.1 Accident investigators should have their investigation field kits and essential personal items packed and ready so that they can proceed without delay to the accident site. Advance consideration should also be given to such details as inoculations, passport requirements and

travel facilities. Investigators who work amongst wreckage are advised to have a valid anti-tetanus serum inoculation and hepatitis immunization, as well as the necessary personal protective equipment against biological hazards, such as blood-borne pathogens. Proper planning and preparedness are essential in facilitating the prompt arrival of investigators at an accident site and have considerable bearing on the efficiency of the investigation.

2.5.2 Accidents are apt to occur anywhere: at airports, in mountains, swamps, deeply wooded areas, deserts, etc. Hardships are often encountered in reaching accident sites in remote areas, and it is therefore important that investigators be physically fit and that working gear be selected with due consideration to terrain and weather.

2.5.3 Clothing should be comfortable and afford protection against the conditions or elements that may be

encountered. Spare clothing may also be required. The most essential items of personal clothing are good footwear, a wind-proof and waterproof jacket and trousers, and appropriate headgear. The investigator should wear suitable boots which provide protection against the hazards at the accident site. Specifically, the boots should provide protection against crushing and piercing injuries and should be waterproof and oil and acid resistant. A “paratroop” type of boot with a heavy moulded sole gives good service as general-purpose footwear in difficult terrain; “desert” boots have been found suitable in dry, broken ground. Protective items, such as sun block, anti-glare spectacles and insect repellent, should also be available.

2.5.4 Before proceeding to the accident site, investigators should have adequate supplies and equipment

most appropriate to the territory to be covered (food, water, first-aid kit, camping gear, communication equipment, etc.) and should have a competent guide if it is necessary to enter wild or rugged terrain. They should anticipate the need for special equipment (i.e. snowmobiles and skis) and have ready access to this type of equipment so that there is no delay in procuring it. They should also be familiar with the use of such equipment.

2.5.5 The investigation field kit should contain sufficient equipment to enable examination of the wreckage, the plotting of impact points and wreckage patterns, parts identification and the recording of observations. The list of items in the Appendix to this chapter provides guidance on the type of equipment which might be selected for the investigation field kit.

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## Appendix to Chapter 2

# INVESTIGATION FIELD KIT

*Note 1.— Investigators should bring to the accident site those items which they expect to use. Usually, there is no need for each investigator to bring all the items in the following list.*

*Note 2.— For a list of personal protective equipment against biological hazards, see the Appendix to Chapter 5.*

### GENERAL

Identification papers, investigator's official tag, armband or high-visibility jacket

Relevant documentation (regulations, accident investigation manual, checklists, report forms, etc.)

Appropriate aircraft manuals and parts catalogues

Emergency funds

### SURVEY EQUIPMENT

Large-scale maps of the accident area

Magnetic compass

Global Positioning System receiver

Laser surveying equipment

Clinometer

Navigational computer, protractor and dividers

Measuring tape, at least 20 m long, and a 30-cm-long ruler

Reel of cord, 50 to 300 m long

### MARKING EQUIPMENT

Labels, tie-on tags and adhesive tags

Flag markers and stakes

Writing material, graph paper, waterproof notebooks and clipboards

Pens, pencils, grease pencils, indelible marking crayons and permanent markers

### TOOLS AND SAMPLING MATERIALS

Tool kit

Waterproof flashlight with spare batteries and bulbs

Small magnet

Multi-purpose knife

Inspection mirror

Magnifying glass (10 x)

Assorted antistatic containers (for electronic components with non-volatile memory) and sterile bottles (for aircraft fuel, oil and fluid samples, as well as for pathological fluid and tissue samples)

Syphons

Plastic bags (assorted) and plastic sheets

Masking tape

### MISCELLANEOUS ITEMS

First-aid kit

Heavy gloves, protective overalls and other protective equipment, such as hard hats, goggles and face masks

Protective clothing and equipment to protect against biological hazards (see the Appendix to Chapter 5)

Model aircraft

Photographic equipment for colour prints/slides (film, zoom lens, macro lens, wide-angle lens and electronic flash unit)

Video camera

Binoculars with integrated compass and distance measuring

Small tape recorder, spare cassettes and batteries

Portable means of on-site communication, e.g. cellular telephone or walkie-talkie, spare batteries

Computer, facsimile machine

## **Chapter 3**

# **PLANNING THE INVESTIGATION**

### **3.1 ACCIDENT INVESTIGATION MANAGEMENT**

3.1.1 To achieve its purpose, an investigation must be properly planned and managed. The main parts of an investigation must be planned so that the members of an investigation team are aware of their various tasks and have the appropriate qualifications to perform them. The plan must also recognize that these tasks will be coordinated by the investigator-in-charge.

3.1.2 When a large aircraft is involved, a sizeable team of investigators, set up in specialized groups, is necessary to properly cover all aspects of the investigation. In some investigations, the areas on which the investigation should focus will become evident at an early stage, and the main investigation effort can then be effectively channelled into these relatively specialized areas. Nevertheless, it is still essential that investigators progress systematically through all aspects of the accident. Whether or not the causes are apparent, the investigation should determine any underlying systemic factors that may have contributed to the accident as well as any non-causal deficiencies that could contribute to future accidents.

3.1.3 In the case of accidents involving small aircraft, the investigation effort is proportionately smaller. The functions are still the same, but the work is undertaken by one or two investigators or, alternatively, by an investigator and a specialist qualified in a particular aspect that requires expert examination. Again, it is stressed that even when small aircraft are involved, pre-investigation planning is essential.

### **3.2 THE INVESTIGATION MANAGEMENT SYSTEM**

3.2.1 This section provides a synopsis of the Investigation Management System. Detailed information on this system can be found in Part II of this manual.

3.2.2 An accident investigation involving a large or complex aircraft will require a large team of investigators in order to conduct the investigation in the most effective and

expeditious way. The effective utilization of the available investigators in a major investigation can be achieved by using the Investigation Management System. The Investigation Management System divides the investigation activities into functional areas, each of which can be assigned to a group within the investigation team. Each investigation group will have as many members as are necessary to examine the particular circumstances of the accident. Normally the group chairperson (the investigator responsible for a group) is an employee of the accident investigation authority of the State conducting the investigation. Members of the investigation groups and supporting experts may be from the accident investigation authority or seconded from other aviation agencies in that or other States. Members of an investigation group should normally have access to all information uncovered in the course of the investigation and are usually required to participate in the investigation until the group report is completed.

3.2.3 The investigation groups that might be formed during a major investigation include: flight operations, maintenance and aircraft records, site survey, survivability/cabin safety, human factors, structures, systems, powerplants, flight recorders, meteorology and air traffic services/airports. The circumstances and complexity of the accident will determine the number and types of groups required. In most investigations, a coordinator provided by the aircraft operator is appointed for liaison duties. The investigator-in-charge should, in most cases, be the person responsible for communications with the accredited representatives from other States participating in the investigation in accordance with Annex 13.

3.2.4 Accident investigation management can be greatly facilitated if the investigator-in-charge utilizes the Investigation Management System, which comprises a flow chart with a number of events. Each event is numbered and has a corresponding descriptive phrase. The flow chart allows the investigators to ensure that the essential sequence of events is followed.

3.2.5 Each event checklist contains a list of tasks. Since these tasks may differ from one State to another due to local conditions and procedures, the checklists should be

reviewed to ensure that the tasks are in line with the procedures of the particular State and that they are appropriate to the organization and conduct of the accident investigation. Arranging the activities and tasks into checklists allows the investigator-in-charge to clearly indicate what is to be accomplished by the investigators and the various groups during the investigation. It also makes it easier for the investigator-in-charge to provide direction and guidance to those persons who are participating in an investigation for the first time and who may require specific advice. The checklists, aside from being part of the Investigation Management System, establish some order in what is often a confusing situation.

3.2.6 The group chairpersons must be knowledgeable about the Investigation Management System and the tasks their groups will be required to carry out. They should be well aware that the outlined tasks are not necessarily exhaustive and that particular circumstances may warrant additional tasks. When using the checklists, it is desirable that the investigators take note of the completion date of each task, any further action required or anything of significance associated with a particular task. Regardless of how much planning goes into the preparation of these checklists, there will inevitably be cases in which the outlined tasks will have to be adapted to the particular circumstances of the investigation.

3.2.7 The flow chart and the checklists help the group chairpersons organize the work of their groups, and the flow chart provides the investigator-in-charge with a tool to monitor progress. At the daily progress meetings, the investigators should report which tasks on their checklists have been completed since their last report, and the investigator-in-charge should record that progress on the flow chart. The advantage of this system is the ease with which the progress of the investigation can be reported to headquarters from the investigation site and the fact that the flow chart at headquarters can be updated to reflect the current status of the investigation.

3.2.8 The Investigation Management System is one of the fundamental tools to be used in a major investigation, and an investigator who is likely to be appointed investigator-in-charge or group chairperson of a major investigation should be familiar with this system prior to attempting to use it in the field. The effectiveness of the system is directly related to how well each investigator adheres to the flow chart and the checklists.

### 3.3 LIAISON WITH OTHER AUTHORITIES

3.3.1 The accident investigation authority must liaise with other authorities, particularly those at or in the vicinity

of airports, to prepare for the eventuality of an aircraft accident. It is important that emergency plans are in place and that the accident investigation authority is aware of the emergency plans of local authorities. Cooperation with the police can usually be obtained through liaison with police headquarters. Suitable items can then be included in the police training syllabus and the official police handbook to ensure that members of the police force are informed, in advance, of what is expected of them in the event of an aircraft accident.

3.3.2 Detailed information concerning the role and responsibility of each agency for each type of emergency is contained in the *Airport Services Manual*, Part 7 — *Airport Emergency Planning* (Doc 9137). Although that manual deals with accidents at an airport, the role and responsibility of each agency outlined therein may also apply to other accidents.

3.3.3 Victim identification is usually the responsibility of the coroner's office, the police department and the disaster victim identification team. Medical personnel, such as pathologists and forensic dentists, should be aware of what is expected of them in the event of an aircraft accident.

3.3.4 Notification of next of kin is a sensitive task that must be planned and undertaken with great care in order to avoid anomalies, such as multiple or erroneous notifications. In many States, the notification of next of kin is a police task.

3.3.5 Although it is recognized that the circumstances surrounding each accident are different, the importance of proper planning and establishing good liaison with other authorities, particularly the police and the rescue and fire-fighting services, cannot be overemphasized. To achieve this, the accident investigation authority may find it beneficial to establish formal Memoranda of Understanding with the various government agencies involved in disaster response, particularly the police department, the department of national defence, and the coroner's office.

3.3.6 The accident investigation authority may have to rely on assistance from other civil and military organizations to provide facilities, equipment and additional manpower, i.e. helicopters, heavy lifting and moving gear, metal detectors, Geiger counters, communication equipment, and divers. It is important that heavy salvage equipment, such as cranes, bulldozers, or lifting helicopters, are readily available. When an extensive wreckage plot is required, it may also be necessary to obtain the services of professional surveyors through liaison with appropriate government agencies. In some cases, a full-scale expedition may have to be mounted, requiring additional transportation, food, lodging, etc.

### 3.4 COOPERATION WITH THE MEDIA

3.4.1 Most major accidents generate a high degree of interest from both the public and the media, and a good rapport with the media is usually an asset to the investigation. It may be necessary to enlist the cooperation of the local media to withhold precise details of the location of an aircraft accident until adequate crowd-control measures can be implemented. It may also be necessary to enlist their aid in obtaining further information about the local area, and the names of possible witnesses or when seeking the public's assistance in recovering missing pieces of the wreckage.

3.4.2 Policies should be adopted regarding the release of information to the media about the accident or the progress of the investigation. To promote dissemination of factual information and to minimize speculation and rumours about the accident, the media should be provided, on a regular basis, with all those facts which can be released without prejudice to the investigation. For this reason, the accident investigation authority should consider establishing a single point of contact for media inquiries. This contact is usually the investigator-in-charge or a designate. The media contact, in consultation with the accredited representatives, should provide non-prejudicial facts and circumstances to the media. Nevertheless, it is necessary to ensure that the needs of the media do not interfere with the proper conduct of the investigation.

3.4.3 Other organizations involved or affected by the accident (such as airlines, airport authorities, emergency services and aircraft manufacturers) may also be required to release information to the media, and such efforts should be coordinated, to the extent possible, amongst the organizations and agencies involved.

3.4.4 The accident investigation authorities and the accredited representatives and their advisers participating in an investigation shall not give the media or the public access to any documents obtained during the investigation without the express consent of the State conducting the investigation. The release of such information by a participating State, without the consent of the State conducting the investigation, would undermine the mutual confidence and cooperation amongst the States involved and must therefore be avoided.

### 3.5 SECURING OF RECORDS, RECORDINGS AND SAMPLES

Regulations and procedures should be in place to ensure that, in the event of an accident, all air traffic services communication recordings and documents deemed to be associated with the flight are secured and placed in safe keeping until further instructions are received from the accident investigation authority. Prior arrangements should also be made to immediately obtain and place in safe keeping all of the aircraft operator's documentation associated with the aircraft, the flight crew and the flight operation. Arrangements should be made with the aviation meteorology authorities to obtain a special weather report as soon as they become aware of an aircraft accident. Similar arrangements should be made with fuel companies to obtain fuel samples from stocks or refuelling points.

### 3.6 REMOVAL OF DISABLED AIRCRAFT

Detailed information concerning planning, equipment and procedures for the removal of disabled aircraft at airports is contained in the *Airport Services Manual*, Part 5 — *Removal of Disabled Aircraft* (Doc 9137).

## **Chapter 4**

# **NOTIFICATION OF ACCIDENTS AND INCIDENTS**

### **4.1 GENERAL**

Immediate notification of accidents and incidents to the accident investigation authority is essential because the proper conduct of an investigation requires the prompt arrival of investigators at the accident site. Any delay in their arrival may well result in the deterioration or disappearance of essential evidence due to theft, displacement or improper handling of the wreckage, adverse weather, corrosion of the wreckage, obliteration of ground scars or contamination of witness accounts through discussion among themselves.

### **4.2 NOTIFICATION WITHIN A STATE**

4.2.1 State regulations should provide for the accident investigation authority to be immediately notified of any accident or incident in its territory. Since accident investigation procedures differ from one State to another, it is not possible to define in detail a standard procedure for the notification of accidents and incidents. However, the following points may serve as a basis for the establishment of a timely notification procedure.

4.2.2 The first persons to know about an accident are any survivors or witnesses. Surviving crew members are likely to know what immediate actions to take, and witnesses or surviving passengers will usually inform the local police, the airport authorities or military personnel, who should immediately notify the accident investigation authority in accordance with a pre-arranged procedure. Sometimes air traffic services personnel are the first to know that an accident has occurred and they will initiate the notification procedure.

4.2.3 The notification procedure should be simple and effective, using the most rapid means of communication (telephone, facsimile or electronic mail). A list of State authorities to be notified should be available at all air traffic services facilities, airport authorities and police departments. The list should be arranged in order of priority and should include the names and telephone numbers of the

appropriate authorities and their alternates, if appropriate. A record should be kept of the persons and organizations notified.

4.2.4 More than one local authority may be responsible for alerting other authorities of an accident. For instance, local airport personnel are usually required to notify the accident investigation authority and the local police. The local police are usually also required to notify the accident investigation authority, as well as the judicial authorities. A check system should be established to ensure that each of the appropriate authorities has been notified.

4.2.5 In the case of reportable incidents, notification to the accident investigation authority is usually initiated by air traffic services or the aircraft operator.

4.2.6 The accident investigation authority should be organized in such a way that accident or incident notifications are received and acted upon on a twenty-four-hour basis.

### **4.3 RESPONSIBILITIES OF THE STATE OF OCCURRENCE**

4.3.1 Annex 13, Chapter 4, contains provisions for the notification of accidents and serious incidents.

4.3.2 When an accident or serious incident occurs in the territory of a Contracting State to an aircraft registered in another Contracting State, the State in which the accident or serious incident occurred (State of Occurrence) shall send a notification with a minimum of delay to the State of Registry, the State of the Operator, the State of Design and the State of Manufacture of the aircraft.

4.3.3 When the State of Occurrence is not aware of a serious incident, the State of Registry or the State of the Operator, as appropriate, shall forward a notification of such an incident to the State of Design, the State of Manufacture and the State of Occurrence.



4.3.4 When an accident or serious incident occurs in the territory of the State in which the aircraft is registered (State of Registry), in a non-Contracting State, or outside the territory of any State, then the State of Registry shall send a notification with a minimum of delay to the State of the Operator, the State of Design and the State of Manufacture of the aircraft.

4.3.5 For accidents or serious incidents to aircraft of a maximum certificated take-off mass of over 2 250 kg, the notification shall also be sent to ICAO.

4.3.6 The State of Occurrence should also notify States which have a special interest in an accident by virtue of fatalities or serious injuries to its citizens, and those States should be permitted by the State conducting the investigation to appoint an expert who should be entitled to, *inter alia*, assist and participate in the identification of the victims.

4.3.7 The State of Occurrence may also wish to send a notification to those States which may be requested to provide information to the investigation authority conducting the investigation, i.e. the State(s) whose air traffic services had the aircraft under control prior to the accident or serious incident.

4.3.8 Each State should have appropriate regulations and procedures in place to ensure that its accident investigation authority sends the notification to the accident investigation authorities of the other States concerned with a minimum of delay. Instructions regarding the preparation and dispatch of notifications should be readily available to the investigator(s) on call.

4.3.9 The accident investigation authority should be organized in such a way that accident investigators are available on a twenty-four-hour basis. This will reduce notification delays and will allow the investigation to begin promptly.

4.3.10 Where possible, the notification should be addressed to the accident investigation authorities in the State of Registry, the State of the Operator, the State of Design and the State of Manufacture, as appropriate.

#### **4.4 FORMAT AND CONTENT OF THE NOTIFICATION**

4.4.1 The notification shall be in plain language and contain as much of the information in the example at

Appendix 1 to Chapter 4 as is available. Its dispatch shall not be delayed due to the lack of complete information. If it has not been possible to provide complete information in the notification, the State of Occurrence shall forward the omitted details as soon as they become available.

4.4.2 Whenever it is possible to do so without causing undue delay, the notification shall be prepared in one of the working languages of ICAO, taking into account the language(s) of the recipients.

#### **4.5 DISPATCH OF THE NOTIFICATION TO OTHER STATES**

4.5.1 The notification shall be sent with a minimum of delay and by the most suitable and quickest means available (i.e. telephone, facsimile or electronic mail).

4.5.2 Appendix 2 to Chapter 4 lists the addresses and contact numbers of States' accident investigation authorities, as reported to ICAO prior to 1 January 2000.

#### **4.6 RECEIPT OF THE NOTIFICATION**

Arrangements should be made in each State to ensure prompt delivery of accident and incident notifications to the accident investigation authority on a twenty-four-hour basis. If notifications cannot be delivered direct to the accident investigation authority, the number of intermediaries should be kept to a minimum.

#### **4.7 RESPONSIBILITY OF THE STATE RECEIVING THE NOTIFICATION**

4.7.1 The accident investigation authority in each State receiving the notification shall, as soon as possible and usually by the same means of communication:

- acknowledge receipt of the notification;
- provide the State of Occurrence with the available relevant information requested;
- inform the State of Occurrence whether or not it intends to be present at the investigation;
- provide the names and titles of the accredited representative and technical advisers and the expected date of their arrival at the accident

site or at the headquarters of the accident investigation authority in the State of Occurrence.

4.7.2 Since the State of Registry, the State of the Operator, the State of Design and the State of Manufacture maintain the right to be represented at the investigation, they may, in the case of a delay in the receipt of the notification, supply the above information on their own initiative. If these States consider it unnecessary to be present at the investigation, each State should so advise the State of Occurrence with a minimum of delay. The

attention of the State of Registry, the State of the Operator, the State of Design and the State of Manufacture is drawn to their obligation to appoint accredited representatives, when specifically requested to do so, for accidents involving aircraft over 2 250 kg. Their attention is also drawn to the usefulness of their participation in the investigation and the fact that it is highly desirable that they participate when requested to do so by the State conducting the investigation. In any case, the State of Design and the State of Manufacture should supply the State conducting the investigation with any information it may request.

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## Appendix 1 to Chapter 4

### EXAMPLE OF A NOTIFICATION

<i>Information required (see Annex 13, 4.2)</i>	<i>Example</i>
a) for accidents the abbreviation ACCID, for serious incidents INCID;	a) ACCID;
b) manufacturer, model, nationality and registration marks, and serial number of the aircraft;	b) Boeing 737-200, United Kingdom, G-AMSW, serial no. 20280;
c) name of owner, operator and hirer, if any, of the aircraft;	c) Derby Aviation;
d) name of the pilot-in-command;	d) Captain X;
e) date and time (local time or UTC) of the accident or serious incident;	e) 7 October 1983 at 1314 hours local time;
f) last point of departure and point of intended landing of the aircraft;	f) London/Heathrow-Perpignan/Riversaltes;
g) location of the accident or incident with reference to some easily defined geographical point, and latitude and longitude; <sup>1</sup>	g) 12 km south of Prades, 42-33 N, 02-26 W, elevation 2 200 m;
h) number of crew and passengers: aboard, killed and seriously injured; others: killed and seriously injured; <sup>2</sup>	h) 6 crew and 57 passengers aboard, all fatally injured; others: none;
i) nature of the accident or serious incident, and the extent of damage to the aircraft so far as it is known;	i) aircraft collided with mountainside in the Canigou Massif. Aircraft destroyed by fire;
j) an indication to what extent the investigation will be conducted or is proposed to be delegated by the State of Occurrence;	j) investigation by the French authorities;
k) physical characteristics of the accident or serious incident area; and	k) mountainous area, difficult access, perpetual snow;
l) identification of the originating authority.	l) Bureau Enquêtes-Accidents, Paris, France. For additional information, contact Mr. X at (telephone and facsimile numbers, and e-mail address).

1. It may be helpful to provide the elevation of the accident site, if it is known.

2. It is useful to first provide the number of persons aboard (crew, passengers) and then the injuries they sustained.

— — — — —

## Appendix 2 to Chapter 4

### ADDRESSES OF ACCIDENT INVESTIGATION AUTHORITIES

#### AFGHANISTAN

President of Civil Aviation Operations  
Ministry of Civil Aviation and Tourism  
Ansari Watt, P.O. Box 165  
Kabul  
Afghanistan

Tel.: (873) 68 2341450 / 49  
Fax: (873) 68 1280784  
AFTN: OAKBYAYX  
Cable: CIVAVIA Kabul

#### ANDORRA

National Civil Aviation Administration  
Département des Transports et de l'Énergie  
Ministère de l'Économie  
Carrer Prat de la Creu, 62-64  
Andorra la Vella  
Andorra

Tel.: (376) 875 700  
Fax: (376) 861 519

#### ALBANIA

Ministry of Public Works and Transport  
Directorate General of Civil Aviation  
Str Abdi Toptani, 2  
Tirana  
Albania

Tel.: (355) 42-26232 / 23969  
Fax: (355) 42-26232 / 23969  
SITA: TIATNXS  
AFTN: LATIYFYX  
Telex: 2124 ASTRAN AB

#### ANGOLA

Direcção Nacional de Aviação Civil  
Rua Miguel de Melo No. 96, 6º Andar  
Caixa Postal 569  
Luanda  
Angola

Tel.: (244) 2 33 85 96  
Fax: (244) 2 39 05 29  
AFTN: FNLUYAYX  
Telex: 4118 DNAC AN  
Cable: AERONAUTICA Luanda

#### ALGERIA

Ministère des transports  
Direction de l'Aviation civile et de la météorologie  
119, rue Didouche Mourad  
Alger  
Algérie

Tel.: (213) 2 74 06 81 (standard)  
(213) 2 74 76 30 (ligne Directeur directe)  
Fax: (213) 2 74 76 14  
(213) 2 74 76 24  
RSFTA: DAALYAYA  
SITA: ALGMTCR  
Telex: 66 129

#### ANTIGUA AND BARBUDA

See Eastern Caribbean States

#### ARGENTINA

Junta de Investigaciones de Accidentes de Aviación Civil  
Avda Belgrano 1370 Piso 11 "B"  
C.P. 1093 Capital Federal  
Buenos Aires  
Argentina

Tel./Fax: (54) 1 1 4381 6333  
E-mail: jiaac@inea.net.ar  
Fax: (54) 1 1 4317 6704 / 5 / 6  
AFTN: SABAYAYX  
Telex: 21763 FUAER AR

**ARMENIA**

General Department of Civil Aviation  
Airport — Zvartnots  
375042 Yerevan  
Armenia

Tel.: (374) 2 771 082 / 282 066  
Fax: (374) 2 151 123  
AFTN: UGEEYAYX  
Telex: 243312

**ARUBA<sup>1</sup>**

Department of Civil Aviation  
Sabana Berde 73-B  
Oranjestad  
Aruba

Tel.: (297) 832665 General  
(297) 824330 (ext. 258)  
E-mail: dca-aaa@setarnet.aw  
Fax: (297) 823038  
AFTN: TNCAAYAX  
Cable: CIVILAIR ARUBA

**AUSTRALIA**

Australian Transport Safety Bureau (ATSB)  
P.O. Box 967, Civic Square  
Canberra A.C.T. 2608  
Australia

Tel.: (61) 2 6274-6464  
(61) 2 6257-4150  
E-mail: atsbinfo@atsb.gov.au  
Fax: (61) 2 6274-6474  
AFTN: ASCOYLYX  
Web site: <http://www.atsb.gov.au>

**AUSTRIA**

Ministry of Science and Transport  
Aircraft Accident Investigation Branch  
Radetzkystrasse 2  
A-1030 Wien  
Austria

Tel.: (43) 1 711 62-9200  
E-mail: fus@bm.vg.at  
Fax: (43) 1 711 62-9299  
Telex: 232 322 1155  
Cable: 232 322 1155

**AZERBAIJAN**

State Concern of Civil Aviation  
Azadlyg, Prospect 11  
37000 Baku  
Azerbaijan

Tel.: 994 12 93 44 34  
Fax: 994 12 98 52 37  
SITA: UBBZZJ2  
AFTN: UBBUDDXX

**BAHAMAS**

Director of Civil Aviation  
P.O. Box N-975  
Nassau-New Providence  
Bahamas

Tel.: (242) 377 7281  
Fax: (242) 377 2010  
AFTN: MYNNYAYX  
Telex: BS109 CADAIR BS  
Cable: CADAIR- BAHAMAS

**BAHRAIN**

Assistant Undersecretary for Civil Aviation  
Ministry of Transportation  
Bahrain International Airport  
P.O. Box 586  
Bahrain

Tel.: (973) 32 3000 / 1000  
Fax: (973) 32 5757  
SITA: BAH APYF  
AFTN: OBBI YAYX  
Telex: 9186

**BANGLADESH**

Civil Aviation Authority  
Flight Safety  
Kurmitola  
Dhaka 1206  
Bangladesh

Tel.: (880) 2 891122  
Fax: (880) 2 893322  
AFTN: VGHQYA  
Telex: 632210 CCAAB BJ  
Cable: CIVILAIR Dhaka

## **BARBADOS**

Technical Director — Aviation  
Air Traffic Services Building  
Grantley Adams International Airport  
Christ Church  
Barbados

Tel.: (246) 428-09309  
Fax: (246) 428-2539  
AFTN: TBPBYAYX  
Cable: CIVILAV BARBADOS

## **BELARUS**

State Aviation Committee  
Civil Aviation Department  
4 Ulitsa Aerodonnaya  
220065 Minsk  
Belarus

Tel.: (375) 172 225 392  
Fax: (375) 172 227 728  
AFTN: UMMDMAXX  
Cable: MSQDSB2

## **BELGIUM**

Bureau Enquêtes — Accidents  
Administration de l'Aéronautique  
Centre Communications Nord — 4e étage  
Rue du Progrès, 80 — Bte 5  
1030 Bruxelles  
Belgique

Tel.: (32) 2 206 32 11  
E-mail: civilair@mobilite.fgov.be  
Fax: (32) 2 203 15 28  
AFTN: EBBSYAYX  
Cable: 22715 DGAIR  
Web site: <http://www.vici.fgov.be>

## **BELIZE**

Civil Aviation Department  
Belize International Airport  
P.O. Box 367  
Belize City  
Belize

Tel.: (501) 25 2052 / 2014  
Fax: (501) 25 2533  
AFTN: MZBZYAYX  
Cable: CIVILAIR Belize

## **BENIN**

Direction de l'Aéronautique Civile  
B.P. 305  
Cotonou  
Benin

Tel.: (229) 30 10 98 / 99  
AFTN: DBBBYAYX  
Cable: AEROCIVIL Cotonou

## **BERMUDA<sup>1</sup>**

The Director of Civil Aviation  
Department of Civil Aviation  
2 Kindley Field Road  
St. George, GE CX  
Bermuda

Tel.: (441) 293 1640  
Fax: (441) 293 2417  
AFTN: TXKFYAYX  
Telex: 02903248 AVCIV BA  
Cable: AVCIV Bermuda

## **BHUTAN**

The Director  
Civil Aviation Division  
Ministry of Communication  
Royal Government of Bhutan  
P.O. Box 291, Thimphu  
Bhutan

Tel.: (975) 2 22499  
Fax: (975) 2 223639 / 22987  
Cable: DIRCEVAVIATION Thimphu

## **BOLIVIA**

Ministerio de Desarrollo Económico  
Subsecretaría de Aeronáutica Civil  
Palacio de Comunicaciones  
Av. Mcal. Santa Cruz No. 1278  
4° Piso  
La Paz  
Bolivia

Tel.: (591) 2 374142  
E-mail: mtctran@wara.bolnet.bo  
Fax: (591) 2 371314  
AFTN: SLLPYAYX  
Cable: AEROCIVIL La Paz

**BOSNIA AND HERZEGOVINA**

Director  
Civil Aviation Authority  
Envera Sebovica br.2  
71000 Sarajevo  
Bosnia and Herzegovina

Tel.: (387) 71 653 016  
Fax: (387) 71 653 008  
AFTN: LQSJYAPK

**BOTSWANA**

The Director  
Department of Civil Aviation  
P.O. Box 250  
Gaborone  
Botswana

Tel.: (267) 365 5200 / (267) 312 062  
E-mail: tmeshesha@gov.bw  
Fax: (267) 353 709 / (267) 303 348  
AFTN: FBHQYAYX  
Cable: AVIATION GABORONE

**BRAZIL**

Centro de Investigação e Prevenção de Acidentes  
Aeronauticos — CENIPA  
SHIS — QI 05 — Área Especial 12  
LAGO SUL  
Brasilia — DF — CEP 71615-600  
Brasil

Tel.: (55) 61 365 1008 / (55) 61 364 8800  
Fax: (55) 61 365 1004  
AFTN: SBBRYLYX  
Telex: 0611152 CENIPA SBRR  
Web site: <http://www.cenipa.aer.mil/br>

**BRUNEI DARUSSALAM**

Director of Civil Aviation  
Ministry of Communications  
Brunei International Airport  
Bandar Seri Begawan BB2513  
Brunei Darussalam

Tel.: (673) 2-330 142  
E-mail: dca@pso.brunet.bn  
Fax: (673) 2-331 706  
AFTN: WBSBYAYX  
Telex: 2267 DCA BU  
Cable: CIVILAIR BRUNEI

**BULGARIA**

Civil Aviation Administration  
Accident Prevention and Investigation Service  
9, Levski Street  
Sofia — 1000  
Bulgaria

Tel.: (359) 2 87 10 79 / (359) 2 87 37 57  
E-mail: caa@mt.government.bg  
Fax: (359) 2 980 53 37 / (359) 2 87 64 32  
SITA: SOFTOYA  
AFTN: LBSFYAYX  
Telex: 22640 AVINS BG  
Cable: AVINS Sofia

**BURKINA FASO**

Direction de l'Aviation Civile  
B.P. 1158  
Ouagadougou 01  
Burkina Faso

Tel.: (226) 30 64 88 / (226) 31 63 32  
Fax: (226) 31 45 44  
AFTN: DFFVYAYX

**BURUNDI**

Directeur de la Régie des Services Aéronautiques  
B.P. 694  
Bujumbura  
Burundi

Tel.: (257) 22.3707 / (257) 21.8656  
Fax: (257) 22.3428  
AFTN: HBBAYAX  
Telex: 5190 AERO BDI  
Cable: MINITPTBU-BUJUMBURA

**CAMBODIA**

State Secretariat of Civil Aviation  
62 Preah Norodom Blvd.  
Phnom Penh  
Cambodia

Tel.: (855) 15 835 373 / 360 617  
Fax: (855) 23 426 169  
SITA: PNHVAYA  
AFTN: VDPYAYX  
Cable: DACK Phnom Penh

#### **CAMEROON**

Direction de l'Aviation Civile  
Yaoundé  
Cameroun

Tel.: (237) 30 3090  
Fax: (237) 30 3362  
AFTN: FKKYYAYX  
Telex: 8214 KN  
Cable: Aérocivile Yaounde

#### **CANADA**

Transportation Safety Board of Canada  
200 Promenade du Portage  
Place du Centre, 4th Floor  
Hull, Quebec K1A 1K8  
Canada

Tel.: (1) 819-994-4252  
(1) 819-997-7887 (24 hour)  
E-mail: [airops@tsb.gc.ca](mailto:airops@tsb.gc.ca)  
Fax: (1) 819-953-9586  
Web site: <http://www.tsb.gc.ca>

#### **CAPE VERDE**

Airports and Air Safety Authority (ASA)  
252 Empresa Nacional de Aeroportos e Sagurança Aerea  
Aeroporto Internacional Amilcar Cabral  
Ilha do Sal  
Cabo Verde

Tel.: (238) 41-13-72  
Fax: (238) 41-15-70  
AFTN: GVACYOYX  
Telex: 4032 ASA CV

#### **CAYMAN ISLANDS<sup>1</sup>**

Director of Civil Aviation  
P.O. Box 277G  
George Town  
Grand Cayman  
West Indies

Tel.: (1) 345 949-7811  
Fax: (1) 345 949-0761  
AFTN: MWCRYAYX  
Telex: 4458 CIVAV CP

#### **CENTRAL AFRICAN REPUBLIC**

Direction Générale de l'Aviation Civile et de la  
Météorologie  
B.P. 941 et 224  
Bangui  
République Centrafricaine

Tel.: (236) 61 53 16  
Fax: (236) 61 49 18  
AFTN: FEFVYAYX  
Telex: 5209 RC  
Cable: MINITRANS-BANGUI

#### **CHAD**

Direction de l'Aviation Civile  
B.P. 96  
N'Djaména  
Tchad

Tel.: (235) 516 231  
AFTN: FTTVYAYX

#### **CHILE**

Dirección General de Aeronáutica Civil  
Miguel Claro 1314  
Prov. Santiago  
Chile

Tel.: (56) 2 204 15  
Fax: (56) 2 335 5710  
AFTN: SCSCYAYX  
Telex: 490532 DAITA CL

#### **CHINA**

General Administration of Civil Aviation of China  
155 Dongsì Street West  
Beijing 100710  
China

Tel.: (86) 10 6401 2233  
Fax: (86) 10 6401 4104 / 6918  
AFTN: ZBBBYAYX  
Telex: 22101 CAXT CN  
Cable: 22101 CAXTCN



**COLOMBIA**

Unidad Administrativa Especial de Aeronáutica Civil  
Aeropuerto Internacional Eldorado  
Apartado Aéreo 12307  
Bogotá, D.E.  
Colombia

Tel.: (57) 1 4139894  
Fax: (57) 1 4139276  
AFTN: SKBOYAYX  
Telex: 044620 DAAC CO

**COMOROS**

Direction Générale de l'Aviation Civile et de la  
Météorologie  
B.P. 72  
Moroni  
Comores

Tel.: (269) 744 245 / 730 447  
E-mail: dgacm@snpt.kn  
Fax: (269) 731 030 / 735 063  
AFTN: FMCNYAYX  
Telex: K0241 PUBLICO

**CONGO**

Direction Générale de l'Agence Nationale de l'Aviation  
civile  
B.P. 128  
Brazzaville  
Congo

Tel.: (242) 82 40 90  
(242) 82 80 61  
Fax: (242) 82 40 90  
AFTN: FCBVYAYX  
Telex: 5388 KG

**COOK ISLANDS**

Department of Civil Aviation  
P.O. Box 61  
Rarotonga  
Cook Islands

Tel.: (682) 22 810  
Fax: (682) 28 816  
AFTN: NCRGYAYX  
Telex: 62052 AVARUA

**COSTA RICA**

Dirección General de Aviación Civil  
Ministerio de Obras Públicas y Transporte  
Apartado Postal 5026  
San José  
Costa Rica

Tel.: (506) 232 9480 / 231 3666  
E-mail: concorde@sol.racsa.co.cr  
Fax: (506) 231 2107  
SITA: SJOTOYA  
AFTN: MRSJYAYX  
Telex: 2926 DGAC

**CÔTE D'IVOIRE**

Agence Nationale de l'Aviation Civile (ANAC)  
07 B.P. 148  
Abidjan 07  
Côte d'Ivoire

Tel.: (225) 27 74 24 / (225) 27 90 04  
Fax: (225) 27 63 46  
AFTN: DIAVYAYX  
Telex: 43452 ANAM CI

**CROATIA**

Ministry of Maritime Affairs, Transport and  
Communication  
Department of Civil Aviation  
Prisavlje 14  
10000 Zagreb  
Croatia

Tel.: (385) 1 6169 060 / 6112 018  
E-mail: up-civilnog-zrakoplovstva@zg.tel.hr  
Fax: (385) 1 6110 153  
AFTN: LDZGYAYX  
Telex: 21275

**CUBA**

Dirección de Seguridad Aeronáutica y Operaciones  
Instituto de Aeronáutica Civil de Cuba  
Calle 23, No. 64 Vedado  
Ciudad de la Habana 4  
Cuba 10600

Tel.: (53) 7 551115  
(53) 7 551111 (24 hours-Spanish only)  
E-mail: iaccdsa@iacc3.get.cma.net  
Fax: (53) 7 334575  
SITA: HAVYACU  
AFTN: MULHYQYX  
Telex: 511737 A CIV CU

#### **CYPRUS**

Department of Civil Aviation  
16 Grivas Dhigenis Ave.  
1429 Nicosia  
Cyprus

Tel.: (357) 2-510 793 / (357) 2-303 200  
E-mail: acc@cytanet.com.cy  
Fax: (357) 2-766 552  
SITA: NICTOYA  
AFTN: LCNCYAYX  
Cable: 6055CIVAIR CY

#### **CZECH REPUBLIC**

Air Accidents Investigation Institute  
Director  
Beranových 130  
199 01 Prague 99  
Czech Republic

Tel.: (420) 225 115 426  
E-mail: INFO@uzpln.cz  
Fax: (420) 225 115 430  
Web site: <http://www.uzpln.cz>

#### **DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA**

Director General  
General Administration of Civil Aviation  
Sunan District  
Pyongyang  
Democratic People's Republic of Korea

Tel.: (850) 2 381 8108  
Fax: (850 2) 381 4625  
SITA: FNJEDJS  
AFTN: ZKKKYAYX  
Telex: 5471 JS KP  
Cable: CIVILAIR Pyongyang

#### **DEMOCRATIC REPUBLIC OF THE CONGO**

Direction de l'Aéronautique Civile  
Ministère des Transports et Communications  
Building Ontara, boulevard du 30 juin  
B.P. 3304  
Kinshasa/Gombe  
République démocratique du Congo

Tel.: (243) 24 21710  
Cable: CIVILAIR KINSHASA

#### **DENMARK**

Aircraft Accident Investigation Board  
Langebjergvaenget 21  
DK-4000 Roskilde  
Denmark

Tel.: (45) 38 71 10 66 (0800 – 1600 hrs)  
(45) 32 51 66 11 (1600 – 0800 hrs)  
E-mail: aaib@hcl.dk  
Fax: (45) 38 71 92 31  
Telex: 16850 AAIB DK  
Cable: AAIBDENM  
Web site: <http://www.hcl.dk>

#### **DJIBOUTI**

Direction de l'Aviation Civile et de la Météorologie  
B.P. (204) 250  
Djibouti  
République de Djibouti

Tel.: (253) 340169 / 341647  
Fax: (253) 355975  
AFTN: HFFFYAYX  
Telex: 5871 PRESIDEN DJ

#### **DOMINICA<sup>2</sup>**

See Eastern Caribbean States

#### **DOMINICAN REPUBLIC**

Dirección General de Aeronáutica Civil  
Edificio de Oficinas Gubernamentales  
Avenida México Esq. Dr. Delgado  
Bloque "A", 2° Piso  
Apartado Postal 1180  
Santo Domingo  
República Dominicana

Tel.: (1) 809 221-8706 / 04  
E-mail: ais.rep.dom@codetel.net.do  
Fax: (1) 809 221-8616  
AFTN: MDCDYFYX  
Cable: DIRACIV-SANTO DOMINGO

**EASTERN CARIBBEAN STATES**

Directorate of Civil Aviation of Eastern Caribbean States  
P.O. Box 1130  
Factory Road  
St. John's  
Antigua

Tel.: (1) 809 462-0907  
E-mail: oecs.dca@candw.ag  
Fax: (1) 809 462-4145  
AFTN: TAPAYAYX  
Telex: 2089 CIVILAV AK  
Web site: [http://www.oecs.org/DCA\\_WEBSITE/contacting\\_the\\_dca.htm](http://www.oecs.org/DCA_WEBSITE/contacting_the_dca.htm)

*Note.— The Directorate of Civil Aviation is operated in conjunction with States comprising the Organization of Eastern Caribbean States: Antigua and Barbuda, Dominica, Grenada, Montserrat, Saint Kitts and Nevis, Saint Lucia, and Saint Vincent and the Grenadines.*

**ECUADOR**

Dirección General de Aviación Civil  
Departamento de Seguridad de Vuelo  
Buenos Aires 149 y Av. 10 de Agosto  
Casilla 2077  
Quito  
Ecuador

Tel.: (593) 2-544-274  
Fax: (593) 2-563-995  
AFTN: SEQUYAX  
Telex: 22710 DACUIO ED

**EGYPT**

Central Department of Aircraft Accident Investigation  
and Prevention  
Civil Aviation Authority  
Ministry of Transport and Communications  
P.O. Box 52, Cairo Airport Road  
Cairo  
Egypt

Tel.: (20) 2 634 9068 / (20) 2 666 850  
E-mail: egoca@idsc.gov.eg  
Fax: (20) 2 247 0351  
SITA: CAIXYYF  
AFTN: HECAYAYX  
Cable: TYARAN-CAIRO

**EL SALVADOR**

Dirección General de Transporte Aéreo  
Aeropuerto de Ilopango  
San Salvador  
El Salvador

Tel.: (503) 295-0265 / (503) 295-0406  
Fax: (503) 295 0345 / (503) 295 0443  
AFTN: MSSSYAYX  
Cable: AEROCIVIL San Salvador

**EQUATORIAL GUINEA**

Ministerio de Transportes y Comunicaciones  
Dirección General de Transportes y Aviación Civil  
Calle Arallia, N° 22  
Malabo (Bioko-Norte)  
República de Guinea Ecuatorial

Tel.: (240) 9 3231 / (240) 9 2062  
Fax: (240) 9 3313  
AFTN: FGSL YD YX  
Telex: GE913101 PUBMBO  
Cable: DIRAVIACIVIL MALABO

**ERITREA**

Director General  
Civil Aviation Department  
P.O. Box 252  
Massaw Street, Bldg Nr. 87  
Asmara  
Eritrea

Tel.: (291) 1 120555 / 124335  
E-mail: asmcaya@sita.gmsmail.com  
Fax: (291) 1 124334 / 181255  
SITA: ASMCAYA  
AFTN: HHAAAYAYX

**ESTONIA**

Civil Aviation Administration  
Parnu Road 6  
EE 0001 Tallinn  
Estonia

Tel.: (372) 63 13818  
E-mail: ecaa@trenet.ee  
Fax: (372) 63 12681  
AFTN: ULTTYAYX

## **ETHIOPIA**

Civil Aviation Authority  
P.O. Box 978  
Addis Ababa  
Ethiopia

Tel.: (251) 1 610277 / 180359  
E-mail: civilaviation@telecom.net.et  
Fax: (251) 1 612533  
SITA: ADDYAYF  
AFTN: HAABYAYX  
Telex: 21162 CIV AIR ET  
Cable: CIVILAIR Addis Ababa

## **FEDERATED STATES OF MICRONESIA**

See Micronesia (Federated States of)

## **FIJI**

Civil Aviation Authority of Fiji  
Private Bag Nap 0354  
Nadi Airport  
Fiji

Tel.: (679) 721 555 / (679) 722 500  
Fax: (679) 721 500  
SITA: NANCAXS  
AFTN: NFHOYAYX  
Telex: 5299 CAAF FJ  
Cable: CIVILAIR NADI

## **FINLAND**

Accident Investigation Board  
Sörnäisten rantatie 33 C  
FIN-00580 Helsinki  
Finland

Tel.: (358) 9 1606 7643  
E-mail: onnettomuustutkinta@om.fi  
Fax: (358) 9 1606 7811  
AFTN: EFHKYAYX  
Telex: 12-1247 AVIA SF  
Web site: <http://www.onnettomuustutkinta.fi>

## **FRANCE**

Bureau d'Enquêtes et d'Analyses pour la  
Sécurité de l'Aviation civile  
Bâtiment 153  
Aéroport du Bourget  
93350 Le Bourget  
France

Tel.: (33) 1 49 92 72 00  
(33) 1 48 35 86 54 (Emergency 24 hours)  
E-mail: bealab@francenet.fr  
Fax: (33) 1 49 92 72 03  
AFTN: LFPSYLYX  
Telex: 203591 F  
Web site: <http://www.bea-fr.org>

## **GABON**

Secrétariat Général à l'Aviation Civile et Commerciale  
B.P. 2.212  
Libreville  
Gabon

Tel.: (241) 76 38 95 / (241) 73 08 28  
Fax: (241) 73 08 25  
AFTN: FOOVYAYX  
Telex: 5352 GO  
Cable: AVIACIVIL Libreville

## **GAMBIA**

Gambia Civil Aviation Authority  
Banjul International Airport  
Yundum, P.O. Box 285  
Banjul  
Gambia

Tel.: (220) 472831, 82167 / 71  
Fax: (220) 472190  
AFTN: GBYDYAYX  
Telex: 2295 MINWOCOM GV  
Cable: CIVILAIR BJL

## **GEORGIA**

Head of Air Transport Department  
Ministry of Transport  
28 Rustaveli Avenue  
380008 — Tbilisi  
Georgia

Tel.: (995) 32 93 30 92  
Fax: (995) 32 98 96 30  
SITA: TBSDMSU  
AFTN: UGGUDD

**GERMANY**

Federal Bureau of Aircraft Accidents Investigation  
Hermann-Blenk-Str. 16  
38108 Braunschweig  
Germany

Tel.: (49) 531 3548 0  
E-mail: box@bfu-web.de  
Fax: (49) 531 3548 246  
Telex: 952749 ACCID D  
Web site: <http://www.bfu-web.de>

**GHANA**

The Director General  
Ghana Civil Aviation Authority  
Private Mail Bag  
Kotoka International Airport  
Accra  
Ghana

Tel.: (233) 21 776171  
E-mail: dg.gcaa@ighmail.com  
Fax: (233) 21 773293  
SITA: ACCATYA  
AFTN: DGAAYAYX  
Telex: 94 2336 GHACAA GH  
Cable: AIRCIVIL ACCRA

**GREECE**

Hellenic Republic  
Ministry of Transport and Communication  
Air Accident Investigation and  
Aviation Safety Board  
Ex. American Base  
Building 221  
Helliniko  
167 01 Athens  
Greece

Tel.: (30) 210 99 73 024  
(30) 69 44 580 464 (24 hour)  
E-mail: nspoul@otenet.gr  
Fax: (30) 210 99 73 184

**GRENADA**

See Eastern Caribbean States

**GUATEMALA**

Dirección General de Aeronáutica Civil  
Aeropuerto Internacional "La Aurora"  
Zona 13  
Guatemala, Centro América

Tel.: (502) 2 331 0311 / 9484  
Fax: (502) 2 331 4840  
AFTN: MGGTYAYZ  
Telex: 3120 ACIVIL GU  
Cable: DAEROCIVIL Guatemala

**GUINEA**

Ministère de l'Équipement  
Direction Nationale de l'Aviation Civile  
B.P. 95  
Conakry  
République de Guinée

Tel.: (224) 45 34 57 / 45 19 28  
Fax: (224) 41 35 77  
AFTN: GUCYYAYX  
Telex: 22349 MITRANS  
Cable: AVIACIVIL CONAKRY

**GUINEA-BISSAU**

Direction Générale de l'Aviation Civile  
C.P. 77  
Bissau  
Guinée-Bissau

Tel.: (245) 21 30 03 / 21 39 61  
AFTN: GGOVYAYX  
Cable: AEROCIVIL Bissau

**GUYANA**

Civil Aviation Department  
Ministry of Public Works and Communications  
Oranapai Towers, Wight's Lane  
Kingston  
P.O. Box 1006  
Georgetown  
Guyana

Tel.: (592) 2 56822 / (592) 2 54080  
Fax: (592) 2 56800  
AFTN: SYTMYAYX  
Cable: CIVILAV

#### HAITI

Office National de l'Aviation civile  
Aéroport International de Port-au-Prince  
B.P. 1346  
Port-au-Prince  
Haiti

Tel.: (509) 46 052  
Fax: (509) 46 0998  
AFTN: MTEGYAYX  
Telex: CIVILAV ITT 2030465

#### HONDURAS

Dirección General de Aeronáutica Civil  
Aeropuerto Internacional Toncontín  
Apartado Postal 30145  
Tegucigalpa, D.C.  
Honduras

Tel.: (504) 233-1115  
Fax: (504) 233-3683  
AFTN: MHTGYAYX  
Telex: 1523 DGAC HO  
Cable: DIRGA-TEGUCIGALPA

#### HONG KONG<sup>1</sup>

Civil Aviation Department  
Queensway Government Offices, 46th Floor  
66 Queensway  
Hong Kong  
China

Tel.: (852) 2-867 4332  
E-mail: cadadmin@vol.net  
Fax: (852) 2-869 0093  
AFTN: VHHYAYX  
Telex: 61361 CADHK HX

#### HUNGARY

Director  
Civil Aviation Safety Board CASABO  
H-1675 Budapest-Ferihegy  
POB 62  
Hungary

Tel.: (36) 296 9504  
(36) 294 5529  
Fax: (36) 296 8808  
Web site: <http://www.caa.hu>

#### ICELAND

Aircraft Accident Investigation Board  
Hus FBSR  
Flugvallarvegi  
101 Reykjavik  
Iceland

Tel.: (354) 511 1666 (0800 – 1600 hrs)  
(354) 569 4141 (1600 – 0800 hrs)  
(354) 660 0336 (24 hour)  
E-mail: [rnf@rnf.is](mailto:rnf@rnf.is)  
Fax: (354) 511 1667  
AFTN: BICAYAY  
Web site: <http://www.rnf.is>

#### INDIA

Office of the Director General of Civil Aviation  
DGCA Complex  
Opposite Safdarjung Airport  
New Delhi 110003  
India

Tel.: (91) 11 4620784  
E-mail: [dgca@hub.nic.in](mailto:dgca@hub.nic.in)  
Fax: (91) 11 4629221  
(91) 11 4633140  
AFTN: VIDDYAYX  
Telex: 31-74127 DGCA IN

#### INDONESIA

National Transportation Safety Committee  
Gedung Karsa, 2nd Floor  
Department of Transport  
Merdeka Barat No. 8  
Jakarta 10110  
Indonesia

Tel.: (62) 21 350 5137  
(62) 21 350 5133  
Fax: (62) 21 350 5139  
AFTN: WIIXYAYX  
Telex: 49482 CIVAIR IA  
Cable: CIVILAIR JAKARTA

**IRAN (ISLAMIC REPUBLIC OF)**

Civil Aviation Organization  
Ministry of Roads and Transportation  
P.O. Box 11365-8315  
Mehrabad Airport  
Tehran  
Islamic Republic of Iran

Tel.: (98) 21 646-9732  
Fax: (98) 21 605-9348  
AFTN: OIIYAYX  
Telex: 213889 EPD IR  
Cable: CIVILAIR, TEHRAN

**IRAQ**

Directorate of Flight Safety  
General Establishment of Civil Aviation  
P.O. Box 23006  
Baghdad International Airport  
Baghdad  
Iraq

Tel.: (964) 1 8863999 (ext. 28278)  
Fax: (964) 1 8880178  
SITA: SDAYAYD  
AFTN: ORBSYDYX  
Telex: 212500 YIA IK  
Cable: SDA

**IRELAND**

Air Accident Investigation Unit (AAIU)  
Department of Transport  
44 Kildare Street  
Dublin 2  
Ireland

Tel.: (353) 1 604 1293  
E-mail: [aaiu@transport.ie](mailto:aaiu@transport.ie)  
Fax: (353) 1 604 1514  
AFTN: EIDWYAYX  
Web site: <http://www.aaiu.ie>

**ISRAEL**

Chief Investigator, Accidents and Incidents  
Civil Aviation Administration  
P.O. Box 8  
Ben Gurion International Airport 70100  
Israel

Tel.: (972) 3-9774600  
E-mail: [hassk@mot.gov.il](mailto:hassk@mot.gov.il)  
Fax: (972) 3-9774593  
AFTN: LLADYAYX  
Telex: 381000 CAATS IL  
Cable: MEMTEUFA-BENGURION AIRPORT-  
ISRAEL

**ITALY**

Agenzia nazionale per la sicurezza del volo  
Via A. Benigni, 53  
00156 Rome  
Italy

Tel.: 39 068 207 8219 / 39 068 207 8200  
Fax: 39 068 273 672

**JAMAICA**

Civil Aviation Authority  
4 Winchester Road  
Kingston 5  
Jamaica

Tel.: (876) 960-3965 / (876) 920-2280  
E-mail: [jcivav@toj.com](mailto:jcivav@toj.com)  
Fax: (876) 920-0194  
AFTN: MKJKYAYX  
Cable: CIVAV JA

**JAPAN**

Director-General  
Secretariat of the Aircraft and Railway Accidents  
Investigation Commission  
Ministry of Land, Infrastructure and Transport  
2-1-2, Kasumigaseki, Chiyoda-ku  
Tokyo 100-8918  
Japan

Tel.: (81) 3 5253 8813  
E-mail: [ARAIC@mlit.go.jp](mailto:ARAIC@mlit.go.jp)  
Fax: (81) 3 5253 1677  
AFTN: RJTDYAYA  
Cable: KOKUKYOKU-TOKYO  
Web site: <http://www.motnet.go.jp/araic/index.html>

## **JORDAN**

Civil Aviation Authority  
Aircraft Accident Investigation Unit (AIU)  
P.O. Box 39257  
Amman 11104  
Jordan

Tel.: (962) 6 445 2027 / (962) 6 489 2282  
(962) 6 445 1140  
E-mail: investigation@jcaa.gov.jo  
Fax: (962) 6 445 1141  
SITA: AMMXYA  
AFTN: OJAMYAYX  
Telex: 21325 CIVAIR JO  
Web site: [http://www.jcaa.gov.jo/air\\_accident\\_investigation.asp](http://www.jcaa.gov.jo/air_accident_investigation.asp)

## **KAZAKHSTAN**

Ministry of Transport and Communications  
Committee for Usage of Airspace and Civil Aviation  
Activity  
458 Seyfullin Avenue  
480083 Almaty  
Kazakhstan

Tel.: (7) 327 2 62 08 56 / 39 34 61  
Fax: (7) 327 2 39 02 87  
AFTN: UAADDRDU  
Telex: 25 12 32 PTB SU

## **KENYA**

The Chief Inspector of Accidents  
Directorate of Civil Aviation  
P.O. Box 30163  
Nairobi  
Kenya

Tel.: (254) 2 822950 (ext. 238)  
Fax: (254) 2 822195  
AFTN: HKNCYAYD  
Telex: KE 25239 DCA HQ  
Cable: DIRECTAIR

## **KIRIBATI**

The Director of Civil Aviation  
Ministry of Information, Communications and Transport  
P.O. Box 277  
Bikenibeu, Tarawa  
Kiribati

Tel.: (686) 28092 / 26003  
Fax: (686) 28280 / 26193  
AFTN: NQTAYF  
Telex: KI77022  
Cable: MINCOM TARAWA

## **KOREA, DEMOCRATIC PEOPLE'S REPUBLIC OF**

See Democratic People's Republic of Korea

## **KOREA, REPUBLIC OF**

See Republic of Korea

## **KUWAIT**

Directorate General of Civil Aviation  
P.O. Box 17 SAFAT  
Kuwait 13001  
Kuwait

Tel.: (965) 476-5815  
(965) 476-2755  
Fax: (965) 476-5796  
SITA: KWIASYA/KWIDDYA/KWIAPYA  
AFTN: OKAAYAYX  
Cable: CIVAIR KUWAIT

## **KYRGYZSTAN**

Ministry of Transport and Communications  
Department of Air Transport and Air Space Use  
184 Ahunbaev St.  
720044 Bishkek  
Kyrgyzstan

Tel.: (996) 7 3312 422515  
Fax: (996) 7 3312 420686  
SITA: FRU...K2  
AFTN: UAFUUKXX



**LAO PEOPLE'S DEMOCRATIC REPUBLIC**

Department of Civil Aviation  
2 Pang Kham Street  
P.O. Box 119  
Vientiane  
Lao People's Democratic Republic

Tel.: (856) 21 215550  
Fax: (856) 21 212043  
AFTN: VLAOYAYX  
Cable: AVIACIVIL Vientiane

**LATVIA**

Civil Aviation Administration  
Airport "Riga"  
LV-1053 Riga  
Latvia

Tel.: (371) 7 207607 / 207507  
E-mail: admin@latcaa.gov.lv  
Fax: (371) 207122  
AFTN: UMRUYAYX  
Telex: 161100 PTB SJ 1237 AVTO

**LEBANON**

Directorate General of Civil Aviation  
Beirut International Airport  
Khalde  
Lebanon

Tel.: (961) 1 629010  
E-mail: dirac@cnrs.edu.lb  
Fax: (961) 1 629011  
AFTN: OLBAYFYX  
SITA: OLBVXSXT  
Telex: LE20314 DGACLN LE  
Cable: CIVILAIR, BEIRUT

**LESOTHO**

Directorate Civil Aviation  
P.O. Box 629  
Maseru 100  
Lesotho

Tel.: (266) 312499  
Fax: (266) 310188  
AFTN: FXMMYAYX  
Telex: 4321 LO  
Cable: CIVILR

**LIBERIA**

Directorate of Civil Aviation  
Ministry of Transport  
P.O. Box 9041-1000  
Monrovia 10  
Liberia

Tel.: (231) 22 66 91  
Fax: (231) 22 75 15  
AFTN: GLRBYAYX  
Telex: 44384 MINTRANS

**LIBYAN ARAB JAMAHIRIYA**

Civil Aviation and Meteorology Higher Institute  
P.O. Box 84116  
Tripoli  
Libyan Arab Jamahiriya

Tel.: (218) 21 3615994 / 3330256  
Fax: (218) 21 3615995  
SITA: TIPYAXS-TIPTOYA  
AFTN: HLLTYAYX  
Telex: 20353 CALLY  
Cable: SIRECTAIR TRIPOLI BYA

**LITHUANIA**

Directorate of Civil Aviation of Lithuania  
Rodunios Kelias 2, Airport  
2023 Vilnius  
Lithuania

Tel.: (370) 2 739 112  
E-mail: Transp@Transp.lt  
Fax: (370) 2 739 122  
AFTN: UMWWYAYX

**LUXEMBOURG**

Ministère des Transports  
Direction de l'Aviation Civile  
19-21, Boulevard Royal  
Boîte postale 590  
L-2938 Luxembourg

Tel.: (352) 478-4413 / 14  
Fax: (352) 467-7790  
AFTN: ELLXYAYX  
Telex: 1465 CIVAIR LU  
Cable: CIVILAIR-LUX

#### **MACEDONIA**

See The former Yugoslav Republic of Macedonia

#### **MADAGASCAR**

Ministère des Transports et de la Météorologie  
Direction de l'Aviation Civile  
B.P. 921 Anosy  
Antananarivo 101  
Madagascar

Tel.: (261) 20 22 35689  
(261) 20 22 28418  
(261) 20 22 44757  
Fax: (261) 20 22 30444  
AFTN: FMMDYAYX

#### **MALAWI**

Director of Civil Aviation  
Private Bag 322, Capital City  
Lilongwe 3  
Malawi

Tel.: (265) 780 577  
E-mail: aviation@malawi.net  
Fax: (265) 784 986  
AFTN: FWHQYAYX  
Telex: 44736 AVIATION MI  
Cable: AVIATION-LILONGWE

#### **MALAYSIA**

Director General  
Department of Civil Aviation  
3rd-5th Floor Block B, Wisma Semantan  
12, Jalan Gelenggang, Bukit Damansara  
50618 Kuala Lumpur  
Malaysia

Tel.: (60) 3-253 9600  
Fax: (60) 3-253 9533  
AFTN: WMKKYAYX  
Telex: PENAWA MA 30128  
Cable: AIRCIVIL KUALA LUMPUR

#### **MALDIVES**

Civil Aviation Department  
Ministry of Transport and Civil Aviation  
2nd Floor, Huravee Building  
Ameer Ahmed Magu  
Malé 20-05  
Maldives

Tel.: (960) 324 986 / 324 983  
E-mail: civav@transcom.gov.mv  
Fax: (960) 323 039  
AFTN: VRMMYAYX  
Telex: 66034 CIVAV MF

#### **MALI**

Direction Nationale de l'Aéronautique Civile  
Ministère des Travaux Publics et des Transports  
B.P. 227  
Bamako  
Mali

Tel.: (223) 22 55 24  
Fax: (223) 22 61 77  
AFTN: GABVYAXY  
Cable: AVIACIVIL Bamako

#### **MALTA**

Department of Civil Aviation  
Luqa Airport  
Luqa Cmr 02  
Malta

Tel.: (356) 222 936 / (356) 249 170  
Fax: (356) 239 278  
AFTN: LMMLYAYX  
Telex: 1654 CAMLT MW  
Cable: CIVILAIR MALTA

#### **MARSHALL ISLANDS**

Directorate of Civil Aviation  
P.O. Box 1114  
Majuro 96960  
Marshall Islands

Tel.: (692) 247 3889  
Fax: (692) 247 7615 / 3888

**MAURITANIA**

Ministère de l'Équipement et des Transports  
Direction de l'Aviation civile  
Boîte Postale 91  
Nouakchott  
Mauritanie

Tel.: (222) 253 337 / (222) 535 78  
Fax: (222) 535 78  
SITA: NKCYAYX  
AFTN: GQNVYAMR  
Cable: MINITRANSPORTS Nouakchott

**MAURITIUS**

Director of Civil Aviation  
S.S.R. International Airport, Plaisance  
Plaine Magnien  
Mauritius

Tel.: (230) 6373531  
E-mail: dcamru@intnet.mu  
Fax: (230) 6373164  
SITA: MRUXTYF  
AFTN: FIMPYAYX  
Telex: 4896 DCAMAU  
Cable: CIVILAIR MAURITIUS

**MEXICO**

Dirección General de Aeronáutica Civil  
Secretaría de Comunicaciones y Transportes  
Providencia No. 807 — 6º piso  
Colonia del Valle  
Codigo Postal 03100  
México, D.F.  
Mexico

Tel.: (52) 55 5 523 33 77  
Fax: (52) 55 5 523 72 07  
AFTN: MMMXYAYX  
Telex: 1764154 ACIAME

**MICRONESIA (FEDERATED STATES OF)**

Division of Civil Aviation Administration  
Department of Transportation, Communications and  
Infrastructure  
P.O. Box PS-2  
Palikir, Pohnpei, FM 96941  
Federated States of Micronesia

Tel.: (691) 320 2865  
E-mail: transfm@mail.fm  
Fax: (691) 320 5853  
AFTN: PTPNYAYX  
Telex: 729-6807

**MOLDOVA, REPUBLIC OF**

See Republic of Moldova

**MONACO**

Service de l'Aviation Civile  
Héliport de Monaco  
MC-98000 Monaco  
La Principauté de Monaco

Tel.: (377) 93 15 80 24 / 99  
Fax: (377) 93 15 87 08  
AFTN: LNM CYAYX  
Telex: 469525 MONAVI

**MONGOLIA**

Civil Aviation Authority of Mongolia  
Airport Buyant-Uhaa International  
Ulaanbaatar 34  
Mongolia

Tel.: (976) 1 313 151  
E-mail: intercaam@magicnet.mn  
Fax: (976) 1 313 127 / 151  
SITA: ULNUGOM  
AFTN: ZMUBYAYX  
Telex: 79323 CAA MH

**MONTserrat<sup>1</sup>**

See Eastern Caribbean States

## MOROCCO

Administration de l'Air  
B.P. 1073  
Rabat-Principal  
Rabat  
Maroc

Tel.: (212) 7 77 45 54 / 35 27  
Fax: (212) 7 77 30 74 / 68 33 76  
AFTN: GMMRYAYA  
SITA: BBAXYYF  
Telex: 36772 M  
Cable: 36772 M

## MOZAMBIQUE

National Civil Aviation Administration  
P.O. Box 227  
Maputo  
Mozambique

Tel.: (258) 1 465416  
Fax: (258) 1 465415  
AFTN: FQHQYAYX  
Telex: 6-175 SEAC MO  
Cable: AERONAUTICA-MAPUTO

## MYANMAR

Department of Civil Aviation  
Headquarters Building  
Yangon International Airport  
P.O. Box 11021 Mingaladon  
Yangon  
Myanmar

Tel.: (95) 1 665 637 / 635 996  
Fax: (95) 1 665 124 / 6078  
AFTN: VYYYYYAYX  
Telex: 21228 CIVAIR BM

## NAMIBIA

Chief, Accident Investigation  
Ministry of Works, Transport and Communication  
Private Bag 12003  
Ausspanplatz  
Windhoek  
Namibia

Tel.: (264) 61 208 8802  
Fax: (264) 61 238 884  
AFTN: FYHQ YAYX

## NAURU

Director of Civil Aviation  
Civil Aviation Authority  
Government Office  
Yaren District  
Nauru, Central Pacific

Tel.: (674) 444 3113  
Fax: (674) 444 3117  
AFTN: ANAUYYAYX  
Telex: 33081  
Cable: GOVNAURU

## NEPAL

Director General of Civil Aviation  
Civil Aviation Authority  
Babar Mahal  
Kathmandu  
Nepal

Tel.: (977) 1-262387 / 262518  
E-mail: cnsatm@mos.com.np  
Fax: (977) 1-262516  
AFTN: VNKTYAYX  
Telex: 2553 DCA NP  
Cable: AIRCIVIL

## NETHERLANDS ANTILLES<sup>1</sup>

Department of Civil Aviation  
Seru Mahuma Z/N  
Curaçao  
Netherlands Antilles

Tel.: (599) 9 8683933  
Fax: (599) 9 8689924  
AFTN: TNCCYAYX  
Telex: 1102 DCA NA  
Cable: CIVILAIR-CURAÇAO

## NETHERLANDS

Dutch Transport Safety Board  
P.O. Box 95404  
2509 CK The Hague  
Netherlands

Tel.: (31) 70-333 70 00  
(31) 800 6353 7888 (24 hour)  
E-mail: aviation@RvTV.nl  
Fax: (31) 70-333 70 77  
AFTN: EHAMYAYL  
Telex: 74592 RLDLI NL  
Web site: <http://www.rvtv.nl>

**NEW ZEALAND**

The Chief Executive  
 Transport Accident Investigation Commission  
 Level 14 St. John House  
 114 The Terrace  
 P.O. Box 10323  
 Wellington 6036  
 New Zealand

Tel.: (64) 4-473-3112  
 E-mail: [inquiries@taic.org.nz](mailto:inquiries@taic.org.nz)  
 Fax: (64) 4-499-1510  
 AFTN: NZHOYAYX  
 Cable: CIVAIR NZ  
 Web site: <http://www.taic.org.nz>

**NICARAGUA**

Dirección General de Aeronáutica Civil  
 Ministerio de Transporte y la Construcción  
 Apartado Postal 4936  
 Managua  
 Nicaragua

Tel.: (505) 2 226 958 / (505) 2 227 517  
 E-mail: [dgacmct@tmx.com.ni](mailto:dgacmct@tmx.com.ni)  
 Fax: (505) 2 227 516  
 AFTN: MNMGYAYX  
 Telex: 1308 AEROCIVIL

**NIGER**

Direction de l'Aviation Civile  
 Ministère des Transports  
 B.P. 727  
 Niamey  
 Niger

Tel.: (227) 72 32 66 / 67  
 Fax: (227) 74 17 56  
 SITA: DRRVSITX  
 AFTN: DRRVYAYX  
 Telex: MINTRANS 5249 NI  
 Cable: AVIACIVILE Niamey

**NIGERIA**

Federal Ministry of Aviation  
 New Federal Secretariat — Annex 3  
 Shehu Shagari Way — PMB 5012  
 Wuse, Abuja  
 Nigeria

Tel.: (234) 9523 2118  
 E-mail: [aiblos@infoweb.abs.net](mailto:aiblos@infoweb.abs.net)  
 Fax: (234) 9523 2113 / 1603  
 AFTN: DNLLYAYX  
 Telex: 26567 FCAA NG  
 SITA: LOSXSYF

**NORWAY**

Aircraft Accident Investigation Board  
 Civil Aviation Administration  
 Postboks 213  
 N-2001 Lillestrøm  
 Norway

Tel.: (47) 64-84 57 60  
 Fax: (47) 64-84 57 70  
 AFTN: ENCAAYAYX  
 Cable: 71032 ENFB N  
 Web site: <http://www.aaib-n.org>

**OMAN**

Directorate General of Civil Aviation and Meteorology  
 Seeb International Airport  
 P.O. Box 1, Postal Code 111  
 Muscat  
 Oman

Tel.: (968) 519 210 / 519 315  
 E-mail: [dgen@dgcam.com](mailto:dgen@dgcam.com)  
 Fax: (968) 510 122  
 AFTN: OOMSYAYX  
 Telex: 5418 DGCAOMAN ON  
 Cable: CIVAIR MUSCAT

#### **PAKISTAN**

Headquarters, Civil Aviation Authority  
Jinnah Terminal Complex  
QIAP  
Karachi Airport — 75200  
Pakistan

Tel.: (92) 91 920 1500  
E-mail: gmmisca@www.fascom.com  
Fax: (92) 91 920 1594  
Telex: 29534 DGCAA PK  
SITA: KHIAPXX to DG HQCAA  
AFTN: OPHQYAYX

#### **PALAU**

Ministry of Commerce and Trade  
P.O. Box 1471  
Koror  
Palau 96940

Tel.: (680) 488 1116 / 587 2111  
E-mail: mincat@palaunet.com  
Fax: (680) 587 3521 / 2222

#### **PANAMA**

Departamento de Prevención e Investigación de Accidentes  
Dirección de Aeronáutica Civil  
Arp. Marcos A. Gelabert — Albbrook  
Vía Diógenes de la Rosa, Edificio 805  
Apartado 7501 y 7615  
Panama 5  
Panama

Tel.: (507) 315-0260  
Fax: (507) 315-0386  
AFTN: MPTOYAYX  
Telex: 2057 CIVILAV PA

#### **PAPUA NEW GUINEA**

Director of Air Safety Investigation  
Department of Civil Aviation  
P.O. Box 684  
Boroko, NCD  
Papua New Guinea

Tel.: (675) 271764  
Fax: (675) 272201  
AFTN: AYPYYAYX  
Telex: 22203 NE

#### **PARAGUAY**

Dirección Nacional de Aeronáutica Civil  
Ministerio de Defensa Nacional  
2º Piso  
Avda. Mariscal López y Vice Presidente Sánchez  
Casilla de Correos 1568  
Asunción  
Paraguay

Tel.: (595) 21 203 614 / 5  
Fax: (595) 21 213 406  
AFTN: SGASYAYX  
Telex: 5313 PY DGAC

#### **PERU**

Dirección General de Aeronáutica Civil  
Ministerio de Transportes y Comunicaciones  
Avenida 28 de Julio #800  
Lima-1  
Peru

Tel.: (511) 433 7800 / 433 3166  
Fax: (511) 433 2808  
AFTN: SPLIYAYD-SPLIYAYX  
Telex: 25511 PE DIGECOM  
Web site: <http://www.mtc.gob.pe>

#### **PHILIPPINES**

Air Transportation Office  
Ninoy Aquino International Airport  
MIA Road  
Pasay City 1300, Metro Manila  
Philippines

Tel.: (63) 2 832 3308  
E-mail: opcenato@wpi.webquest.com  
Fax: (63) 2 833 0125  
AFTN: RPLLYAXX

#### **POLAND**

The State Commission of Aircraft Accident Investigation  
(SCAAI)  
Ministry of Transport and Maritime Economy  
ul. Chalubinskiego 4/6  
00-928 Warszawa 67  
Poland

Tel.: (48) 22 630-11-42  
Fax: (48) 22 630-11-43  
SITA: WAWGILO  
AFTN: EPWWYAYX  
Telex: 816651 MTIGM

**PORTUGAL**

Cabinete de Prevenção e Investigação  
de Acidentes com Aeronaves (GPAA)  
Rua do Conde Redondo n.º 8-2º direito  
1150-105 Lisboa  
Portugal

Tel.: (351) 21 330 33 20  
24 hours: (351) 21 330 33 45  
E-mail: geral@gpaa.gov.pt  
Fax: (351) 21 330 33 50  
AFTN: LPPTYLYX

**QATAR**

Department of Civil Aviation and Meteorology  
P.O. Box 3000  
Doha  
Qatar

Tel.: (974) 426262  
Fax: (974) 429070  
AFTN: OTBDYAYX  
Telex: 4306 CIVAIR DH  
Cable: CIVILAIR DOHA

**REPUBLIC OF KOREA**

Aviation Safety Division  
Civil Aviation Bureau  
Ministry of Construction and Transportation  
1 Chungang-Dong  
Kwachon-City Kyunggi-do  
Republic of Korea 427-760

Tel.: (82) 2 504-9183  
E-mail: airsaf@moct.go.kr  
Fax: (82) 2 503-7329  
AFTN: RKSLYAYX  
Telex: KK24778  
Cable: CIVIL AIR SEOUL

**REPUBLIC OF MOLDOVA**

State Administration of Civil Aviation  
Airport  
MD 2026 Chisinau  
Republic of Moldova

Tel.: (373) 2 524064 / 525766  
Fax: (373) 2 529118 / 529190  
AFTN: LUKKYGYX

**ROMANIA**

Ministry of Transport  
Department of Civil Aviation  
38 Dinicu Golescu Blvd., Sector 1  
77113 Bucharest  
Romania

Tel.: (40) 1 222-3737 / 638-6868  
Fax: (40) 1 223-1485 / 222-5579  
SITA: BUHYARO  
AFTN: LRBBYAYA  
Telex: 11181 AIRBUHR

**RUSSIAN FEDERATION**

Federal Aviation Authorities of Russia  
State Oversight Flight Safety Department  
37 Leningradsky Prospect  
125167 Moscow  
Russian Federation

Tel.: (7) 095 155-5784  
Fax: (7) 095 155-5535  
SITA: MOWYASU  
AFTN: UUUFYLY

Interstate Aviation Committee  
Air Transport Accident Investigation Commission  
Building 22/2/1  
Bolshaya Ordynka Street  
109017 Moscow  
Russian Federation

Tel.: (7) 095 951-1686  
Fax: (7) 095 953-1145  
AFTN: UUUUZDD

**RWANDA**

Direction de l'Aéronautique  
B.P. 898  
Kigali  
Rwanda

Tel.: (250) 75971  
Fax: (250) 72971  
AFTN: HRYRYAYX  
Cable: DIRAVIAMET Kigali

**SAINT KITTS AND NEVIS<sup>2</sup>**

See Eastern Caribbean States

**SAINT LUCIA**

See Eastern Caribbean States

**SAINT-PIERRE ET MIQUELON<sup>1</sup>**

Service de l'Aviation Civile  
Blvd de Port-en-Bessin  
B.P. 4265 Saint-Pierre  
97500 Saint-Pierre et Miquelon

Telex: 914439 DDE SPM  
AFTN: LFVPYAYX  
Cable: AVIACIVIL Saint-Pierre

**SAINT VINCENT AND THE GRENADINES**

See Eastern Caribbean States

**SAMOA**

Ministry of Transport: Civil Aviation, Marine and Shipping  
P.O. Box 1607  
Apia  
Samoa

Tel.: (685) 23 290 / 2  
E-mail: sectport@samoa.net  
Fax: (685) 20 048  
AFTN: NSFAYD  
Telex: 21 MALO SX  
Cable: MALO APIA

**SAN MARINO**

Ministry of Communications and Transport  
Via A. di Suberchio  
47898 Cailungo  
San Marino

Tel.: (378) 549 992 345

**SAO TOME AND PRINCIPE**

Direction de l'Aviation Civile  
C.P. 97  
Sao Tomé  
Sao Tomé-et-Principe

Tel.: (239) 22062 / 21154  
Fax: (239) 21848  
AFTN: FPSTYA  
Telex: 245 DAC ST  
Cable: AERONAUTICA São Tomé

**SAUDI ARABIA**

Presidency of Civil Aviation  
P.O. Box 887  
Jeddah 21165  
Saudi Arabia

Tel.: (966) 2 640-5830 / 5000  
Fax: (966) 2 640-5877  
AFTN: OEJDYAYX  
Telex: 601093 CIVAIR SJ  
Cable: CIVILAIR JEDDAH

**SENEGAL**

Direction de l'Aviation Civile  
B.P. 8184  
Aéroport de Dakar-Yoff  
Sénégal

Tel.: (221) 20 04 03  
Fax: (221) 20 39 67  
AFTN: GOO YAYX  
Telex: 51206 SG  
Cable: AVIACIVIL SENEGAL

**SERBIA AND MONTENEGRO**

National Civil Aviation Administration (NCAA)  
Federal Ministry of Transport and Telecommunication  
Omladinskih brigada 1  
11070 Novi Beograd  
Serbia and Montenegro

Tel.: (381 11) 311 73 47  
Fax.: (381 11) 311 75 18

**SEYCHELLES**

Directorate of Civil Aviation  
P.O. Box 181 Victoria  
Mahé  
Seychelles

Tel.: (248) 373 001 / 373 533  
E-mail: dcaadmin@seychelles.net  
Fax: (248) 384 009  
AFTN: FSIAYNYX  
Telex: 2239 DCA SZ  
Cable: DIRECTAIR SEYCHELLES



**SIERRA LEONE**

Director of Civil Aviation  
Ministry of Transport and Communications  
Ministerial Office Block  
George Street  
Freetown  
Sierra Leone

Tel.: (232) 22 22106 / 26191  
Fax: (232) 22 228 488  
AFTN: GFLLYA  
Telex: SE3574  
Cable: AIRCIVIL Freetown

**SINGAPORE**

Air Accident Investigation Bureau of Singapore  
Changi Airport Post Office  
P.O. Box 1005  
Singapore 918155

Tel.: (65) 6541 2799  
(65) 6541 2800  
(65) 6541 2796  
Fax: (65) 6542 2394  
AFTN: WSSSYAYX  
Telex: RS 21231 AVIATEL  
Cable: AIRCIVIL  
Web site: <http://www.mot.gov.sg>

**SLOVAKIA**

Civil Aviation Administration  
M.R. Stefanik Airport  
823 05 Bratislava  
Slovakia

Tel.: (421) 7 4857 4055  
E-mail: [selnekovic@sli.sk](mailto:selnekovic@sli.sk)  
Fax: (421) 7 4342 0331 / 4509  
SITA: BTSTOYA  
AFTN: LZIBYIYX, or LZIBYIYP  
Telex: 92264 MDSR SK

**SLOVENIA**

Ministry of Transport and Communications  
Civil Aviation Authority  
Langusova 4  
SI-1535 Ljubljana  
Slovenia

Tel.: (386) 61 17 88 165  
Fax: (386) 61 17 88 149  
SITA: LJUXXYF  
AFTN: LJLAYAYX  
Telex: 39160 SL RUZPYU

**SOLOMON ISLANDS**

Civil Aviation Division  
Ministry of Culture, Tourism and Aviation  
P.O. Box G20  
Honiara  
Solomon Islands

Tel.: (677) 36561 / 3  
Fax: (677) 36775  
AFTN: AGGHYAYX  
Telex: 66470 HQ  
Cable: CIVILAIR Honiara

**SOMALIA**

Somali Civil Aviation Authority  
Flight Safety Division  
P.O. Box 1737  
Mogadishu  
Somalia

Tel.: (252) 1 20203  
AFTN: HCMMYAYX  
Telex: 3033 MINTRAS  
Cable: CIVAIR Mogadishu

**SOUTH AFRICA**

General Manager, Safety Promotion  
Civil Aviation Authority  
Private Bag X 08  
Waterkloof 0145  
Pretoria  
South Africa

Tel.: (27) 12 426 0118  
E-mail: [mail@caa.co.za](mailto:mail@caa.co.za)  
Fax: (27) 12 426 0160  
Web site: <http://www.caa.co.za>

#### **SPAIN**

Comisión de Investigación de Accidentes  
e Incidentes de Aviación Civil  
Ministerio de Fomento  
C\Fruela, 6 — 1ª planta  
28011 Madrid  
Spain

Tel.: (34) 91 597 89 60  
E-mail: [ciaiac@mfom.es](mailto:ciaiac@mfom.es)  
Fax: (34) 91 463 55 35  
AFTN: LEACYAYX  
Telex: 27702 CIAIR E  
Web site: <http://www.mfom.es/ciaiac>

#### **SRI LANKA**

Department of Civil Aviation  
Supreme Building, 5th-7th Floor  
64, Galle Road  
Colombo 03  
Sri Lanka

Tel.: (94) 1 333 447  
E-mail: [sldgca@slt.lk](mailto:sldgca@slt.lk)  
Fax: (94) 1 424 540  
AFTN: VCCCYAYX  
Telex: 22229 MINDEF CE  
Cable: AirCIVIL Colombo

#### **SUDAN**

Director General of Civil Aviation Authority  
Technical Services and Flight Safety  
P.O. Box 430, Nile Avenue  
Khartoum  
Sudan

Tel.: (249) 772 360 / 770 617  
Fax: (249) 779 715  
AFTN: HSSSYAYG  
Telex: 22650 DGACA ASD

#### **SURINAME**

Permanent Secretary  
Ministry of Transport, Communications and Tourism  
Prins Hendrikstraat 26-28  
Paramaribo  
Suriname

Tel.: (597) 420 100 / 420 422  
E-mail: [tctdir@sr.not](mailto:tctdir@sr.not)  
Fax: (597) 420 425 / 420 100  
AFTN: SMPBYAYX  
Telex: 148 CIVPBM SN  
Cable: CIVILAIR

#### **SWAZILAND**

Ministry of Public Works and Transport  
Directorate of Civil Aviation  
Swazi Bank Building  
P.O. Box 58  
Mbabane 4100  
Swaziland

Tel.: (268) 48683  
E-mail: [dca@iafica.sz](mailto:dca@iafica.sz)  
Fax: (268) 48682  
AFTN: EDMBYQ  
Telex: 2104 WD

#### **SWEDEN**

Board of Accident Investigation  
P.O. Box 12538  
S-102 29 Stockholm  
Sweden

Tel.: (46) 8 441 3823  
E-mail: [stfgd@havkom.se](mailto:stfgd@havkom.se)  
Fax: (46) 8 441 3821  
Web site: <http://www.havkom.se>

**SWITZERLAND**

Département fédéral de l'environnement, des transports,  
de l'énergie et des communications (DETEC)  
Bureau d'enquêtes pour les accidents d'aviation (BEAA)  
Bundeshaus Nord  
CH-3003 Berne  
Switzerland

Tel.: (41) 31 322 5544  
(41) 31 810 4151  
(41) 13 831 111 (24-hour — ask for AAIB)  
Fax: (41) 31 322 5599  
(41) 31 810 4150  
SITA: BRNZLYA  
AFTN: LSSOYAYX  
Cable: 912601 OFA CH  
Web site: <http://www.bfu.admin.ch>

**SYRIAN ARAB REPUBLIC**

Directorate General of Civil Aviation  
P.O. Box 6257  
Damascus  
Syrian Arab Republic

Tel.: (963) 11 3331306  
Fax: (963) 11 2232201  
AFTN: OSDIYAYX  
Telex: 411928 CIVAIR SY

**TAJIKISTAN**

Aircompany "Tajik Air"  
734006 Dushanbe  
Titova Str. 32/1  
Tajikistan

Tel.: (7) 3772 212247  
Fax: (7) 3772 510041 / 218685  
SITA: DYUWW7J  
AFTN: UTDDTJKW

**TANZANIA**

See United Republic of Tanzania

**THAILAND**

Ministry of Transport and Communications  
38 Ratchadamnoen Nok Avenue  
Pomprab Sattru Phai  
Bangkok 10100  
Thailand

Tel.: (66) 2 281 3422 / 281 9515  
Fax: (66) 2 280 1714  
AFTN: VTBAYAYX  
Telex: 70000 MINOCOM TH  
Cable: CIVILAIR Bangkok

**THE FORMER YUGOSLAV REPUBLIC OF MACEDONIA**

Ministry of Transport and Communications  
Directorate General of Civil Aviation  
Dame Gruev 1  
91000 Skopje  
The former Yugoslav Republic of Macedonia

Tel.: (389) 91 14 82 20  
Fax: (389) 91 14 82 39  
SITA: SKPAPYF  
AFTN: LWSKYSYX

**TOGO**

Direction de l'Aviation Civile  
B.P. 2699  
Lomé  
Togo

Tel.: (228) 263 740  
(228) 265 574  
Fax: (228) 260 860  
AFTN: DXXXYAYX

**TONGA**

Ministry of Civil Aviation  
P.O. Box 845  
Queen Salote Road  
Nuku'alofa  
Tonga

Tel.: (676) 24 144  
(676) 24 045  
Fax: (676) 24 145  
AFTN: NFTNYAYX  
Telex: 66269 PRIMO TS  
Cable: CIVILAIR TONGA

#### **TRINIDAD AND TOBAGO**

Director of Civil Aviation  
P.O. Box 552  
89 Abercromby Street  
Port of Spain  
Trinidad and Tobago

Tel.: (1) 809 625 9842 / 3  
Fax: (1) 809 625 3456  
AFTN: TTPSYAYX  
Cable: CIVILAV Trinidad

#### **TUNISIA**

Ministère du Transport  
Direction Générale de l'Aviation Civile  
13, Rue 8006 — Monplaisir 1002  
Tunis  
Tunisie

Tel.: (216) 1 794424  
Fax: (216) 1 794227  
SITA: TUNXYYF  
AFTN: DTTVYAYX  
Telex: 13545 CIVIAC TN  
Cable: CIVIAC 13545

#### **TURKEY**

Directorate General of Civil Aviation  
Ministry of Transport and Communications  
Talât Pa\_a Bulvari, No. 4  
Gar 06330  
Ankara  
Turkey

Tel.: (90) 312 212 4635  
Fax: (90) 312 212 4684  
SITA: ANKYXYA  
AFTN: LTAAYAYX  
Telex: 44659 CAD TR

#### **TURKMENISTAN**

Department of Transport and Communications  
National Civil Aviation Administration  
Chary Nurymov Street, 3a  
744000 Ashgabad  
Turkmenistan

Tel.: (993) 12 35 10 52 / 511804  
Fax: (993) 12 35 44 02  
SITA: ASBTCT5  
AFTN: UTAUYAYX  
Telex: 228 118 AKHAL RU

#### **TURKS AND CAICOS ISLANDS<sup>1</sup>**

Department of Civil Aviation  
Grand Turk  
Turks and Caicos Islands

Tel.: (1) 649 946 2138  
Fax: (1) 649 946 1185

#### **UGANDA**

The Managing Director  
Civil Aviation Authority  
P.O. Box 5536  
Kampala  
Uganda

Tel.: (256) 41 321 308  
E-mail: caa@starcom.ug.com  
Fax: (256) 41 320 964  
AFTN: HUENYAYX  
Cable: 61508 CAA UGA

#### **UKRAINE**

Aircraft Accident Investigation Board  
State Aviation Administration  
Pr. Peremogy 14  
252135 Kyiv  
Ukraine

Tel.: (380) 44 216 4271  
Fax: (380) 44 216 4271 (24 hour)  
AFTN: UKKAPLXX

#### **UNITED ARAB EMIRATES**

General Civil Aviation Authority  
P.O. Box 6558  
Abu Dhabi  
United Arab Emirates

Tel.: (971) 2 444 7666  
E-mail: atmuae@emirates.net.ae  
Fax: (971) 2 499 1599 / 405 4485  
AFTN: OMAEYAYX

**UNITED KINGDOM**

Air Accidents Investigation Branch  
 Department of Environment, Transport and the Regions  
 Berkshire Copse Road  
 Aldershot  
 Hants  
 GU11 2HH  
 United Kingdom

Tel.: (44) 1252 510300  
 (44) 171 890 5999 (after hours)  
 E-mail: enquiries@aaib.gov.uk  
 Fax: (44) 1252 376999  
 AFTN: EGGCYLYX  
 Telex: 858119 ACCINV G  
 Web site: <http://www.dft.gov.uk>

**UNITED REPUBLIC OF TANZANIA**

The Chief Inspector of Accidents  
 Ministry of Communications and Transport  
 Accident Investigation Branch  
 P.O. Box 2819  
 Dar es Salaam  
 United Republic of Tanzania

Tel.: (255) 22 2115079  
 (255) 22 2115080  
 E-mail: tcaa@tcaa.go.tz  
 Fax: (255) 22 2118905  
 AFTN: HTDQYAYA  
 Telex: 41120 DIRECTAIR  
 Web site: <http://www.aviationauthority.org>

**UNITED STATES**

National Transportation Safety Board  
 490 L'Enfant Plaza East, SW  
 Washington, DC 20594  
 United States

Tel.: (1) 202-314-6290 (24 hours)  
 E-mail: communicationscenter@ntsb.gov  
 Fax: (1) 202-314-6293  
 AFTN: KRWAYAYL  
 Cable: TRANSAFETY Washington, DC  
 Web site: <http://www.nts.gov>

**URUGUAY**

Sr. Director Nacional de Aviación Civil e Infraestructura  
 Aeronáutica  
 Mercedes 1256  
 C.P. 11100  
 Montevideo  
 Uruguay

Tel.: (598) 2 903 2014  
 E-mail: dinacia@adinet.com.uy  
 Fax: (598) 2 902 1258  
 (598) 2 903 2014  
 AFTN: SUMUCAR UY 2228  
 Telex: DINACIA UY23412  
 Cable: AEROCIVIL — MONTEVIDEO

**UZBEKISTAN**

State Inspection of the Republic of Uzbekistan for Flight  
 Safety Supervision  
 ul. Nujusskaya 73B  
 Tashkent GSP-700015  
 Uzbekistan

Tel.: (7) 3712 136 73 75  
 Fax: (7) 3712 136 01 83 / 133 24 29  
 SITA: TASDDHY, TASCAHY  
 AFTN: UTTTYAYX  
 Telex: 116169 POLET

**VANUATU**

Director of Civil Aviation  
 Pacific Building  
 Private Mail Bag 068  
 Port-Vila  
 Vanuatu

Tel.: (678) 22819  
 Fax: (678) 23783  
 SITA: VLICBYA  
 AFTN: NVVVYAYX  
 Telex: 1040 VANGOV

**VENEZUELA**

Oficina de Inspectoría Aeronáutica  
 Parque Central, Torre Este, Piso 34  
 Apartado de Correos 17587  
 Caracas  
 Venezuela

Tel.: (58) 2 509-2403 / 2457 / 2404 / 2436  
 Fax: (58) 2 509-2425  
 AFTN: SVCCYAYX  
 Telex: 24626 MTCAC VC  
 Cable: DIGETRAERO-CARACAS

**VIET NAM**

Director General  
Civil Aviation Administration  
Gia Lam Airport  
Hanoi  
Viet Nam

Tel.: (84) 4 827 3384  
Fax: (84) 4 827 1913  
SITA: HANCFVN  
AFTN: VVVVYAYX  
Telex: 412242 BGTVT VT

**YEMEN**

Civil Aviation and Meteorology Authority  
Civil Aviation Sector  
P.O. Box 7251  
Sana'a  
Yemen

Tel.: (967) 1 421198 / 413832  
E-mail: CIVILAVIATION@Y.NET.YE  
Fax: (967) 1 421198  
AFTN: OYSNYAYX  
Cable: CIVILAIR

**ZAMBIA**

The Director  
Department of Civil Aviation  
P.O. Box 50137  
Ridgeway  
Lusaka  
Zambia

Tel.: (260) 1 253 149  
E-mail: dca@zamnet.zm  
Fax: (260) 1 251 841  
AFTN: FLHQYFDYQX  
Telex: 42280 ZA  
Cable: AVIATION LUSAKA

**ZIMBABWE**

Civil Aviation Authority  
Karigamombe Centre, 16th Floor  
Samora Machael Ave.  
Private Bag 7716  
Causeway Harare  
Zimbabwe

Tel.: (263) 4 756 418 / 9  
(263) 4 765 751  
E-mail: gtm@africaonline.co.sw  
Fax: (263) 4 756 748  
SITA: HREXTYF  
AFTN: FVHAYZYX  
Telex: 4738 ZW

- 
1. Dependent territory
  2. Non-Contracting State
-

## Chapter 5

# ACTIONS AT THE ACCIDENT SITE

### 5.1 INITIAL ACTIONS

5.1.1 Local fire and police departments will probably be the first officials to arrive at an aircraft accident site, and it is therefore important to enlist their cooperation to ensure that vital evidence is not lost through interference with the wreckage. Such cooperation is usually best achieved through liaison at the headquarters' level, the initial liaison having been effected during the planning associated with the possibility of an aircraft accident. The fire and police departments should be aware of what is expected of them in the event of an aircraft accident, and plans and arrangements for the following essential tasks should be in place so that they can be accomplished without delay:

- a) notifying the rescue coordination centre;
- b) notifying the aircraft accident investigation authority and other authorities as necessary;
- c) securing the wreckage from fire hazards and further damage;
- d) checking for the presence of dangerous goods, such as radioactive consignments or poisons being carried as freight, and taking appropriate action;
- e) placing guards to ensure that the wreckage is not tampered with or disturbed;
- f) taking steps to preserve, through photography or other appropriate means, any evidence of a transitory nature, such as ice or soot deposits; and
- g) obtaining the names and addresses of all witnesses whose testimony may aid in the investigation of the accident.

5.1.2 Apart from these arrangements, the wreckage should be left undisturbed until the arrival of the investigation team. It should be emphasized to the police and rescue services that the bodies of persons killed in an accident involving a large aircraft should, where practicable, be left *in situ* for examination and recording by the

disaster victim identification team, as well as by the investigation team. Similarly, personal belongings should remain untouched as their location may assist in the identification of the victims. In general, disturbance of the wreckage should be limited to that necessary to rescue survivors, extinguish fires and protect the public.

5.1.3 The cooperation of airport personnel is normally ensured through an appropriate standing instruction which should also ensure the safe keeping of air traffic services recordings and documents.

### 5.2 RESCUE OPERATIONS

5.2.1 The primary concern of the first persons to arrive at the site of an aircraft accident is the rescue and aiding of survivors and the protection of property within the means available. Persons who are involved with the extrication of victims from aircraft wreckage should, at the earliest opportunity, record their observations regarding the location in the aircraft where the survivors were found and what portions of the wreckage had to be moved during the rescue. If circumstances permit, the bodies of persons killed in the accident should be left as found until their location and condition are recorded, photographs are taken and a chart is made indicating their location in the wreckage. If bodies are located outside the wreckage, their location should be marked by a stake with an identifying number. A corresponding label should be attached to each body stating where it was found. The careful recording of this data is essential to the identification of bodies and also provides information which may assist in the accident investigation.

5.2.2 In the event that bodies have been removed from the aircraft wreckage before the arrival of investigators, it is important to establish whether or not a record, as set out above, has been maintained. If not, the rescue personnel should be interviewed in order to establish such a record.

5.2.3 Investigators should determine if there has been any disturbance of the wreckage during the rescue operations and should record any such disturbance.

5.2.4 Upon completion of the initial rescue operation, rescue personnel should exercise as much care as possible to ensure that their movements do not destroy evidence which may be of value to the investigation. For example, once the survivors have been rescued and the fire risk has been eliminated as far as practicable, movement of ambulances and fire vehicles should not be permitted along the wreckage trail.

### 5.3 SECURITY

5.3.1 When notified of an accident, the investigator-in-charge should immediately verify that arrangements have been made to ensure the security of the wreckage. This is usually arranged through the police, but in some cases, military personnel or specially recruited civilians may be employed.

5.3.2 When it is suspected that the aircraft may have carried dangerous cargo such as radioactive consignments, explosives, ammunition, corrosive liquids, liquid or solid poisons or bacterial cultures, special precautions should be taken to station the guards at a safe distance from the wreckage. This is particularly important if a fire has occurred because it tends to disperse the contaminants. Signs indicating a potentially dangerous area should be posted until experts have thoroughly evaluated the danger involved.

5.3.3 Upon arrival at the accident site, one of the first tasks of the investigators should be to review the security arrangements. The guards should be thoroughly conversant with their duties, which are to:

- a) protect the public from the hazards in the wreckage;
- b) prevent disturbance of the wreckage (including bodies and contents of the aircraft);
- c) protect property;
- d) admit to the accident site only persons authorized by the aircraft accident investigation authority; and
- e) protect and preserve, where possible, any ground marks made by the aircraft.

5.3.4 Clear and specific instructions should be given to those guarding the wreckage site on the need for authorized persons to have proper identification. In the case of major investigations, this can be accomplished through the issuance of badges or some form of security pass to all

authorized persons. The use of armbands or jackets that show affiliation and duty has also proven to be effective.

5.3.5 If the wreckage has not been scattered, effective security can be achieved by roping off the area (see Figure I-5-1). However, if there is a long wreckage trail, the task of securing the site may be formidable and many guards will be required.

5.3.6 The police can be of considerable assistance in liaising with the local population, particularly with regard to locating outlying pieces of wreckage. While persons living in the neighbourhood should be encouraged to report the discovery of pieces of aircraft wreckage, the importance of leaving these pieces undisturbed should also be impressed upon them. Collecting outlying pieces of wreckage and arranging them into neat piles alongside the main wreckage are sometimes done with good, but misguided, intentions. With no record of where such pieces were found, their value to the investigation is diminished. Similarly, the removal of pieces of wreckage by souvenir hunters must be prevented.

5.3.7 The wreckage should be guarded until the investigator-in-charge is satisfied that all evidence at the site has been gathered. The investigator-in-charge should review the situation periodically and arrange for the progressive release of guards as appropriate.

### 5.4 SAFETY AT THE ACCIDENT SITE

#### 5.4.1 General

Investigators should be aware of the potential hazards at an accident site and what precautions to take. For this reason, some States designate a site safety coordinator. The investigator-in-charge or the site safety coordinator should brief the investigation team on all known and potential hazards and should establish safety practices. The support of the fire department and the dangerous goods specialists should be enlisted, as necessary, to evaluate existing and potential hazards and to brief the investigation team, as appropriate. It should be noted that the role of investigators is to investigate the accident, not to fight fires or remove hazardous materials.

#### 5.4.2 Urban accident sites

Accident hazards in an urban area may include downed power lines, leaking natural gas, propane, heating oil or





**Figure I-5-1. An accident site roped off**

other flammable liquids or gases, and buildings that have become structurally unsound from fire or impact damage. An evaluation of the hazards by experts may be required before accessing the area or buildings.

#### **5.4.3 Precautions to be taken against fire**

There is a high fire risk associated with most aircraft wreckage, and precautions should be taken to ensure the safety of all personnel as well as to protect the wreckage. Fire-fighting equipment should be readily available while a high fire risk remains, and there should be no smoking permitted within the guarded area. Aircraft batteries should be disconnected as soon as possible and if aircraft fuel tanks are still intact, they should be emptied. The quantity of fuel removed from each tank should be measured and recorded. If there has been a large spillage of fuel, the investigators must control any activity that could increase the possibility of ignition, such as the moving of parts of the wreckage. Care should be exercised to control possible sources of ignition, such as static electricity. Likewise, the operation of radio or electrical equipment or the use of salvage equipment should be avoided until the fire risk has been assessed and eliminated.

#### **5.4.4 Precautions to be taken with dangerous cargo**

5.4.4.1 The accident investigation authority should ascertain whether or not dangerous goods were carried aboard the aircraft. A preliminary check of the freight manifest and an inquiry to the operator should resolve this question. Dangerous goods may include such items as radioactive consignments, explosives, ammunition, corrosive liquids, liquid or solid poisons or bacterial cultures.

5.4.4.2 With increasing frequency, radioactive materials are being carried as aircraft freight. If such materials are carried, steps must immediately be taken to have them removed by qualified personnel before any harm is caused to persons working in close proximity to the wreckage. Limitations on the quantity of radioactive material, authorized to be carried on-board an aircraft, the strength of its packaging and shielding will minimize the possibility of container damage in an aircraft accident. As long as the packaging and shielding remain intact, there is likely to be little danger from radiation. However, a post-impact fire could damage the packaging and shielding, and the ensuing heat may cause the radioactive material to change into gaseous form, in which case radiation may spread. In such

cases, all participants in the rescue and fire-fighting operations should be checked, decontaminated and placed under medical observation, as necessary. No examination of the wreckage should be initiated until the level of radiation has been measured and the site declared safe.

5.4.4.3 Accidents involving aerial spraying have the potential to expose investigators to hazardous materials in the form of pesticides and insecticides. With a few exceptions, these chemicals are toxic, even in small quantities. At the accident site, personal protective equipment must be used, and face masks equipped with appropriate filters should be worn.

## 5.4.5 Wreckage hazards

5.4.5.1 The handling of wreckage is inherently hazardous and requires the use of protective clothing and appropriate equipment. Wreckage may shift, roll over or be suspended in trees and may need to be secured. The moving of large parts of wreckage should be supervised by investigators and carried out by professional operators using appropriate equipment. This applies in particular when cranes are used. In such instances it is advisable for investigators to remain upwind of the wreckage so as to limit their exposure to soot, dust and other airborne substances. If, for some reason, a part of the wreckage is left suspended, no work should take place underneath it or nearby, in case the cables and chains should fail or the wreckage shift.

5.4.5.2 There are many hazards specific to a wreckage such as: pressure containers, flares, generators and accumulators. Pressure containers include oxygen bottles, evacuation slide inflation bottles, fire extinguishers and protective breathing equipment. Solid state chemical oxygen generators can reach temperatures of 400 degrees Celsius when they are activated. All such items should be rendered safe and removed from the site.

Other hazards include:

*Tires.* Tires may be damaged on impact or in a hard landing and thus could explode at any time. Tires should be approached from the front or the rear and should be deflated as soon as possible.

*Propellers.* Some propellers have feathering springs, and if the hub is cracked, it can come apart forcefully. Investigators should not attempt to take apart a propeller assembly. Disassembly and inspection is best done at a properly equipped facility.

*Batteries.* Batteries should be disconnected and removed from the site. Caution should be exercised

when disconnecting and removing batteries because sparks could ignite spilled fuel and other flammable materials. Also, battery acid is extremely corrosive.

*Flammable liquids and gases.* Flammable liquids and gases can ignite or explode. The inhalation of fuel vapours or the direct contact of fuel with the skin is harmful. The aircraft should be defuelled and the amount of fuel removed should be recorded. Smoking should not be permitted at the accident site.

*Firearms/ammunition.* Such items might be aboard the aircraft and should be removed by experts.

*Military aircraft and its equipment.* Military aircraft may have ejection seats, armaments, pyrotechnics or munitions. They may also contain exotic or heavy metals, hydrazine or other substances that may be hazardous when burned. Munitions experts should deactivate and remove such equipment from the accident site.

*Depleted uranium.* This material is sometimes used in counter-balance weights in larger aircraft. It can be hazardous if the outer protective coating is breached.

*Radioactive materials.* Such materials may be carried as cargo or used in aircraft components, such as in the engine ice-detection system of some aircraft.

*Soot and insulation materials.* Soot and insulation materials are hazardous in confined spaces, such as the cabin or cargo bins. Face masks and eye protection should be worn when working in such spaces.

5.4.5.3 Composite materials typically consist of carbon/graphite or boron/tungsten and are found in many parts of an aircraft, including the structural skin, control surfaces, access panels, cabin materials, cabin seats, rotor blades and propeller blades. In fact, some aircraft are built entirely of composite materials. Fibreglass is found in soundproofing blankets, cockpit and cabin panels, cargo bin liners and other aircraft furnishings. Composite materials and fibreglass may be hazardous to the eyes, skin and respiratory system, especially if the wreckage has been damaged by fire.

5.4.5.4 When dealing with composites and fibreglass in the wreckage, the following safety precautions apply:

- When handling these materials, investigators should avoid the fibre dust by remaining upwind and wearing goggles and face masks.
- Disposable coveralls may be needed. Contaminated clothing should be washed separately.

- Splinters from fractured fibreglass panels and composites may cause injuries and should be handled with gloves.
- If composite and fibreglass materials have been damaged by fire, they should be sprayed with water or preferably with a fifty-fifty solution of acrylic floor wax and water before handling.

#### 5.4.6 Biological hazards

5.4.6.1 Accident investigators are at risk of exposure to biological hazards, including blood-borne pathogens such as the human immunodeficiency virus (HIV) and the hepatitis B virus (HBV). Biological hazards may be present in the cockpit and cabin wreckage as well as on the ground where bodies and survivors have lain. Since it is not possible to readily identify contaminated blood and other commingled bodily fluids, it is prudent to take precautions when working around and in the wreckage, when handling the wreckage at the site and when performing off-site examinations and tests on wreckage parts.

5.4.6.2 Precautions must be taken to prevent the viruses from entering mucous membranes (such as the eyes, nose and mouth) or non-intact skin such as open cuts or rashes. The accident site may contain liquid, semi-liquid and dried blood, other bodily fluids, fragmented bones, tissues and internal organs. In the dried state, particles of these substances may become airborne and come into contact with the unprotected eyes, nose and mouth.

5.4.6.3 As part of the investigation-planning process, appropriate precautionary measures should be taken. Investigators and others who work on-site or carry out off-site examinations and tests of wreckage parts should take a biological hazard precaution course, and they should also be inoculated against the hepatitis B virus. The following procedures should be developed and implemented:

- a system to maintain records of training and vaccinations;
- procedures to ensure that the biological hazard area is identified and that precautions are maintained throughout an investigation;
- procedures for the maintenance of a personal protective equipment inventory;
- proper methods for donning, removing and disposing of contaminated personal protective equipment;
- work practices to minimize exposure;
- procedures for decontaminating investigation equipment and wreckage parts;
- procedures for shipment of contaminated wreckage parts to off-site examination and test facilities; and
- procedures to follow when exposure to biological hazards has occurred.

5.4.6.4 General guidelines on personal protective equipment are contained in the Appendix to this chapter. A kit containing personal protective equipment should be made available to each investigator. The kit should include a full-cover protective suit, several pairs of latex gloves, work gloves, face masks, goggles, shoe covers and protective boots, disinfection chemicals and a biological hazard disposal bag (see Figure I-5-2).

5.4.6.5 Procedures to be followed at the accident site should include an initial survey for biological hazards in the form of visible blood or other bodily fluids. When there are serious injuries or fatalities, there will often be bodily fluids remaining after the dead and injured are removed. Areas contaminated by spilled blood or bodily fluids should be identified and roped off and have only one single point of entry/exit. Only persons using personal protective equipment should be allowed access to the contaminated areas. Any components that are removed from the accident site for examination and testing should be treated with the same care as exercised at the accident site.

5.4.6.6 Investigators should always assume that human tissue and bodily fluids are contaminated, and as a minimum precaution, they should don a face mask and wear latex gloves under their work gloves when examining wreckage known to contain blood or other fluids. The most common contaminated items include all cabin interior materials, i.e. seat belts/shoulder harnesses, seat cushions, other upholstery and trim materials, and instrument panels. While wearing personal protective equipment in the biological hazard area, investigators should not eat, drink or smoke; apply cosmetics, lip balm or sun block; touch the face, eyes, nose or mouth; or handle contact lenses.

5.4.6.7 Biological hazard waste, such as clothing and contaminated personal protective equipment, should be disposed of. Investigators should carefully pull off the outer work gloves first, then peel off the latex gloves and drop both pairs into a biological hazard disposal bag. Contaminated personal protective equipment should **never** be reused. Exposed skin should be wiped immediately with moist towelettes, then washed with soap and water or a solution of one part chlorine bleach to ten parts of water. A new bottle of bleach solution should be mixed every day.

Contaminated eyes should be flushed with fresh water. Special attention should be given to thorough hand washing after removing latex gloves and before eating, drinking, smoking, or handling contact lenses.

5.4.6.8 Investigators should be aware that wearing personal protective equipment in hot and humid climates may result in heat stroke unless precautions are taken to minimize heat stress. Thus, before donning personal protective equipment, a litre or more of water should be consumed. Depending upon the heat and the humidity, and on the amount of physical exertion required, it may be necessary to limit the amount of time that investigators can wear personal protective equipment. Once they have left the biological hazard area, removed and disposed of their personal protective equipment and disinfected their hands, investigators should rest in the shade and consume at least a litre of water. It may be necessary to have medical personnel assess the condition of investigators who have experienced heat stress.

5.4.6.9 Since it is important to minimize the number of investigators, tools and equipment that could come into direct contact with contaminated materials, only a selected number of investigators should be assigned to handle wreckage and disassemble components. Other investigators could be assigned to take notes, draw diagrams, take photographs or use the manuals and engineering drawings.

5.4.6.10 Contaminated investigation equipment, such as tools, flashlights and tape measures, should be cleaned with soap and water, disinfected and allowed to dry. Personnel, when leaving the area, should place in biological hazard disposal bags any equipment that cannot be readily disinfected. The disposal bags and their contents are usually incinerated at appropriate facilities, such as hospitals.

#### 5.4.7 Psychological stress

An accident may cause serious stress to persons involved in the work at the accident site. In particular, major accidents with a large number of fatalities may induce psychological stress, not only in investigators, but also in persons involved in the search for and identification of bodies. The accident investigation authority should have procedures and personnel in place to identify and aid those who show symptoms of stress.

#### 5.4.8 Helicopter operations

5.4.8.1 Helicopters are often used to reach accident sites in rugged terrain and remote areas as well as for:

- travelling to and from the accident site;
- searching for and removing bodies and wreckage;
- aerial photography; and
- flying the flight path of the accident aircraft.

5.4.8.2 All persons associated with helicopter operations should be briefed on proper safety procedures, including the use of exits, headsets, restraint systems, emergency equipment and, if involved in over-water operations, the flotation gear. The safety briefing should also address how to approach the helicopter, the main and tail rotor hazards, and the effects of rotor wash.

### 5.5 ENVIRONMENTAL AND NATURAL HAZARDS

#### 5.5.1 General

Environmental and natural hazards include extreme climate, mountainous terrain, deserts, jungles, swamps, poisonous plants, dangerous animals and insects. In environments such as these, investigators should work in pairs, carry a first aid-kit and have a means of communication.

#### 5.5.2 Extreme climate

5.5.2.1 Investigators may be faced with extremes of heat and cold depending on the terrain and the time of year. Investigators expecting to spend a few hours at a remote site could find themselves spending the night if their transportation is unable to return for them. Before departure, the current and forecast weather conditions should be checked.

5.5.2.2 In *cold weather*, the following precautions should be taken:

- Wear sufficient protection to prevent frostbite and hypothermia.
- Wear layered clothing that will absorb perspiration.
- Be aware of white-out conditions — disorientation can occur in uniformly bright and white surroundings.
- Wear sunglasses and sun block.
- Drink liquids to prevent dehydration.

5.5.2.3 In *hot weather*, the following precautions should be taken:





**Figure I-5-2. Personal protective equipment used when examining wreckage debris**

- Bring sufficient liquids for personal drinking needs.
- In situations involving high temperatures and humidity, combined with heavy exertion, drink at least half a litre of water or juice per hour.
- Be aware of symptoms of heat stress and heat stroke.
- Wear a wide-brimmed hat and loose-fitting clothing.
- Wear sun block.
- Limit physical exertion above 8 000 feet above sea level.
- Keep hands free on steep climbs.
- Rest frequently.
- Have oxygen available at high altitudes.
- Drink water or juice often to avoid dehydration.
- Wear sun block, sunglasses and a hat.
- Seek advice from the local guides who should, ideally, be accompanying the investigation team.

### **5.5.3 Mountainous terrain**

The main concern with working at high elevations is altitude sickness which is characterized by dizziness, headaches, loss of appetite, difficulty sleeping, aches and pains, a pale complexion and loss of energy. Activities should be paced to conserve energy. If altitude sickness is suspected, the person should sit or lie down. In severe cases, the person should descend immediately to a lower altitude. The following precautions are recommended for working in mountainous terrain:

### **5.5.4 Deserts, jungles and swamps**

If the accident site is located in a desert, jungle or swamp environment, the following safety precautions should be taken.

#### *Deserts:*

- Wear a wide-brimmed hat, loose-fitting clothing, sunglasses, sun block, and goggles.

- Bring plenty of drinking water.
- Limit activities during the heat of the day and set up open-sided sun shelters.
- Employ local drivers; navigating on sand dunes and unmarked roads can be hazardous even in a four-wheel drive vehicle.
- Ensure that appropriate clothing and shelter suitable for temperature decreases at night are available.

#### *Jungles:*

- Secure trouser legs and the tops of boots with rubber bands, strings or duct tape to protect against leeches, insects and crawlers.
- Bring plenty of drinking water.
- Compensate for the heat and humidity by reducing activities.
- Maintain communications with others in the party.

#### *Swamps:*

- If swamp boats are used as a means of transportation, wear a life jacket and ear plugs.
- If walking in water, wear chest waders and use a tall walking stick to find level footing and to determine water depth.
- Prevent swamp water from coming into contact with open cuts and sores, since swamp water may be contaminated.
- Avoid travel or work at night.
- Wear clothing that covers the skin and a wide-brimmed hat with a mosquito net.
- Protect against insects and leeches, as well as snakes, alligators and crocodiles.

### **5.5.5 Poisonous plants, dangerous animals and insects**

5.5.5.1 The danger from plants, animals and insects varies with location, weather, elevation, time of year, etc., and the advice of local experts should be obtained.

5.5.5.2 Although most wild animals will avoid contact with humans, there are some species that are dangerous, and investigators should take precautions on the basis of advice from local experts. Poisonous snakes are prevalent in many areas and snake bite serums should be included in the investigator's first-aid kit.

5.5.5.3 In many areas, mosquitoes transmit malaria and yellow fever. Any protective product that contains "DEET" in a 25 to 30 per cent solution should be an effective mosquito repellent. Concentrations of "DEET" higher than 30 per cent may, however, irritate the skin. It should be noted that mosquito repellents of this type contain a solvent that may melt plastics found on cameras, watches, small tools, etc. Anyone working in areas where malaria and yellow fever are prevalent should take anti-malarial drugs and be inoculated against yellow fever.

5.5.5.4 Ticks, which inhabit fields and forests, may carry bacterial diseases, such as Lyme disease, a bacterial infection caused by the bite of an infected tick. The following precautions should be taken when working in areas that may be infested with ticks:

- Wear long pants and long sleeves. Secure pant legs with duct tape or rubber bands.
- Spray a permethrin-type tick repellent on clothing.
- Use a repellent containing the compound DEET on exposed skin areas, except for the face.
- Check the entire body for ticks daily.
- Immediately remove ticks from the skin.

## **5.6 WRECKAGE IN WATER**

### **5.6.1 Locating the wreckage**

5.6.1.1 As soon as it has been determined that the wreckage is in water, efforts must be made to obtain the best technical expertise available. Naval authorities, marine salvage services and accident investigation authorities of other States known to have experience in this field should be consulted. Advice may also be obtained from fishermen and oceanographers whose knowledge of local conditions, such as configuration of lakes, sea beds and local currents, is often extensive. The first step is to ascertain the most probable point of impact based on floating wreckage, witness reports, search and rescue reports and radar recordings. Buoys should be positioned at the estimated point of impact.

5.6.1.2 If the water is shallow (less than 60 m), search methods using divers can be effective. If the wreckage is located in deeper water, or conditions make it difficult to use divers, use of the following equipment should be considered:

- underwater equipment used to locate the underwater locating devices on the flight recorders;
- underwater videos and cameras;
- side-scan sonar equipment; and
- manned or unmanned submersibles.

### 5.6.2 Decision to recover the wreckage

The circumstances and location of an accident will determine whether salvage of the wreckage is practicable. In most cases, wreckage should be recovered if it is considered that the evidence it might provide would justify the expense and effort of a salvage operation. If the wreckage is likely to contain evidence significant to air safety, the accident investigation authority must provide the impetus needed to ensure that action is promptly taken to recover the wreckage. There have been several instances where aircraft wreckage has been successfully recovered from deep water. Major parts of the wreckage of a DC-9 were recovered from a depth of 3 500 m in the Mediterranean Sea (see Figure I-5-3); a Boeing 747 was recovered from approximately 2 000 m in the Atlantic Ocean (see Figure I-5-4); and a Boeing 747 Combi was recovered from approximately 4 500 m in the Indian Ocean (see Figures I-5-5 and I-5-6). Such recoveries necessitated expensive salvage operations lasting several months, but the results exceeded expectations, and the evidence obtained from the wreckage established the causes of the accidents.

### 5.6.3 Wreckage distribution

Once the wreckage has been located, a chart plotting the wreckage distribution should be prepared. In shallow waters, this can be achieved by divers. In deep waters, underwater video cameras from remotely controlled submersibles may be used. The state of the various pieces of wreckage, their connection by cables or pipes, the cutting of these connections for the salvage operations, etc., should be recorded before lifting the various pieces of wreckage from the bottom. Usually the divers will not be experienced in aircraft accident investigation and, therefore, detailed briefings will be necessary.

### 5.6.4 Preservation of the wreckage

5.6.4.1 The rates at which various metals react with salt water vary considerably. Magnesium components react quite violently and, unless recovered within the first few days, may be completely dissolved. Aluminium and most other metals are less affected by immersion in salt water. For example, a DC-9 recovered from a depth of 3 500 m showed little corrosion after having been submerged for twelve years (Figure I-5-7 refers). However, corrosion will rapidly accelerate once the component is removed from the water, unless steps are taken to prevent it.

5.6.4.2 Once the wreckage has been recovered, its components should be thoroughly rinsed with fresh water. It may be convenient to hose the wreckage as it is raised out of the sea prior to it being lowered onto the salvage vessel. Freshwater rinsing does not stop all corrosive action. When large aircraft are involved, it may not be practicable to take further anti-corrosion action on large structural parts. However, all components that require metallurgical examination will require further preservation. The application of a water-displacing fluid will provide additional corrosion protection; fracture surfaces should then be given a coat of corrosion preventives such as oil or inhibited lanolin.

5.6.4.3 When organic deposits, such as soot deposits or stains, require analysis, organic protective substances should not be used. Freshwater rinsing should be employed followed by air drying. When the component is completely dry, it should be sealed in a plastic bag with an inert desiccant such as silica gel.

5.6.4.4 Flight recorders should not be dried but should be kept immersed in fresh water until the assigned flight recorder specialist assumes responsibility for them.

### 5.6.5 Precautionary measures

5.6.5.1 Safety precautions must be taken when recovering the wreckage. In particular, consideration should be given to deflating tires and pressure containers as early as possible. Corrosion of magnesium wheel assemblies can progress rapidly to the extent that the wheel assemblies become safety hazards. Other pressure containers should be discharged as soon as their contents have been evaluated.

5.6.5.2 The operation of recovery equipment and the supervision of salvage personnel should be left to the salvage contractor. If necessary, the investigator should provide advice on how to attach cables, hooks, etc., to the wreckage to ensure that it is not unnecessarily damaged during the recovery.



**Figure I-5-3.** The flight data recorder of a DC-9 photographed at a depth of 3 500 m in the Mediterranean Sea (1980 accident)



**Figure I-5-4.** The nose gear of a Boeing 747 photographed at a depth of 2 000 m in the Atlantic Ocean (1985 accident)





**Figure I-5-5. The cockpit voice recorder of a Boeing 747 Combi photographed at a depth of 4 500 m in the Indian Ocean (1987 accident)**

5.6.5.3 When salvage barges, which are equipped with large machinery, hoists, cables, nets, rigging equipment, etc., are used, investigators should exercise caution and, in particular, should remain clear of equipment and sling loads.

## **5.7 PLANNING FOR SPECIALIST EXAMINATIONS**

### **5.7.1 General**

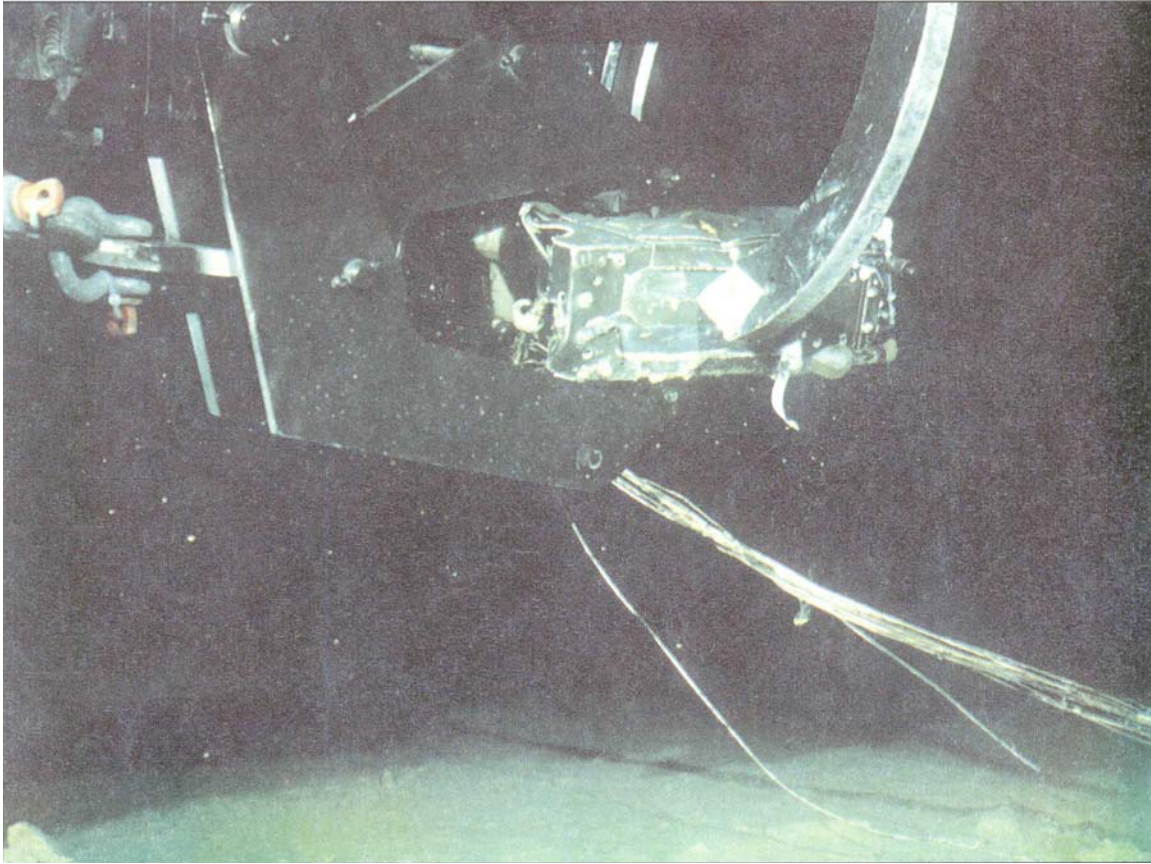
5.7.1.1 If the investigator-in-charge determines that specialist examination or testing of specific components is required, it should be borne in mind that the national legislation of some States may forbid the removal of any part from the wreckage without the agreement of the judicial authorities. For components requiring destructive testing, it may be advisable to obtain written authorization from both the owner of the aircraft and the insurance company.

5.7.1.2 Sometimes it is necessary to send a part, or parts, of a damaged aircraft to another State for technical

examination or testing. In accordance with Annex 9 — *Facilitation*, each State concerned shall ensure that the movement of such part, or parts, is effected without delay. The States concerned shall likewise facilitate the return of such part, or parts, to the State conducting the investigation.

5.7.1.3 Specialist examinations may range from a scanning electron microscope examination of a failed part to chemical analysis, systems testing or flight testing. Laboratory examination and testing generally entail the use of specialized equipment not available in the field and often beyond the capability of an aircraft maintenance facility. Consideration should be given to using the component manufacturer's facilities where specialized equipment and trained personnel are readily available.

5.7.1.4 Laboratory testing should not be limited to standard tests. In addition to testing for compliance with appropriate specifications, it is sometimes necessary to determine the actual properties of the specimen (such as metal, material, fuel and oil). Occasionally it is necessary to devise special tests that will fully exploit the component's capabilities. A wide range of specialized testing equipment will permit simulation of a variety of malfunctions, the only limitation being the ingenuity of the investigators.



**Figure I-5-6. A remotely operated vehicle (ROV) recovers the cockpit voice recorder at a depth of 4 500 m (1987 accident)**

5.7.1.5 When investigators forward failed parts or components for laboratory testing, they should provide as much information as possible relative to the circumstances contributing to the failure of such parts or components, including their own suspicions. The information provided by the investigator is intended only as a guideline to the specialist who should, nevertheless, explore all relevant aspects. It is not sufficient for an investigator to forward parts for specialist examination with the innocuous instructions “for testing”. The investigator should provide a detailed history of the part or component, covering such items as:

- the date it was installed on the aircraft;
- the total number of service hours;
- the total number of hours since last overhaul or inspection;

- previous difficulties reported; and
- any other pertinent data that might shed light on how and why the part or component failed.

5.7.1.6 In order to preserve evidence, it is essential that failed parts and components requiring specialist examination be extracted from the wreckage with care. Systems, whether mechanical, electrical, hydraulic or pneumatic, should be removed in sections as large as practicable. Relevant sections should preferably be dismantled rather than cut. Paint smears, which are often extremely important in collision accidents and in-flight failures, require protection. This also applies to smoke or soot smears.

## **5.7.2 Practical arrangements**

5.7.2.1 The nature of the specialist examination and the type of components and systems to be tested will





**Figure I-5-7. The flight data recorder of a DC-9 showed little corrosion after having been submerged for twelve years in the Mediterranean Sea (1980 accident)**

determine the facility to be chosen. The investigator must be confident that the facility chosen is capable of providing the required examination and testing. Prior arrangements should be made with the facility as far in advance as practicable so that the facility's management can plan the tests and assign personnel and equipment.

5.7.2.2 When choosing a system and components for specialist examination and testing, it is desirable to include as many components of the system as practicable, e.g. wiring harnesses, relays, control valves and regulators. Tests conducted on a single component will reveal information about the operation of that particular unit only, whereas the problem may actually have been in one of the related components. The most valid test results will be obtained by using as many of the original system components as possible.

5.7.2.3 Each component should be tagged with its name, part number, serial number and the accident identifier. The investigator should maintain a listing, descriptive notes and photographs of all components which are to be tested; the components themselves should be kept in protective storage until ready for shipping.

5.7.2.4 Components should be packed to minimize damage during transport. Particular care should be taken to ensure that fracture surfaces are protected by appropriate packing material so that they are not damaged by mating surfaces coming into contact with each other or with other parts.

5.7.2.5 Whenever possible, powerplants should be shipped in their special stands and containers. Other heavy components, such as flight control power-units, stabilizer screw jack assemblies and actuators, should be packed in protective wrapping and placed in separate wooden containers. Blocks or bracing should be installed inside the containers to prevent any movement of the component during transport. Smaller and lighter components may be shipped in the same manner with more than one to a box but in a manner which will prevent them from coming into contact with one another. Very light units may be packaged in heavy corrugated pasteboard cartons with sufficient packing material to prevent damage from mishandling during transport. The investigators should label all boxes and cartons appropriately and should make an inventory list for each container.

### 5.7.3 Notes and test results

5.7.3.1 Notes concerning special examinations and testing should be kept by the facility personnel, and the results should be recorded on the standard forms used by the facility for such work. The investigator supervising the work should also take notes.

5.7.3.2 Prior to conducting the examinations and tests, the investigator(s) and the facility personnel involved should be briefed on the type and extent of the tests to be carried out and should review the test procedures to ensure their adequacy.

5.7.3.3 Any discrepancies found during testing should be photographed and documented with an explanation as to their bearing on the operation of the system or component.

It should be kept in mind that the tolerances called for in the test procedures may only apply to new or overhauled components and that components which have been in service for some time may have acceptable limits outside these tolerances. If the nature of the discrepancy so warrants, a component should be disassembled following completion of the tests to ascertain the cause of failure. Photographs should be taken of the parts prior to and during disassembly, and the findings should be documented.

5.7.3.4 Following completion of the testing, the investigator(s) and facility personnel should review and discuss the results. When there is agreement that the data gathered present a true and factual picture of the component's condition and capabilities, the notes and test results should be reproduced to serve as a record of the examination and testing of the system or component.

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## Appendix to Chapter 5

# PERSONAL PROTECTIVE EQUIPMENT AGAINST BIOLOGICAL HAZARDS

The following provides general guidelines on the personal protective equipment to be used by accident investigators at the accident site. The protective equipment may also be required when performing off-site examinations and tests on wreckage parts.

*Disposable latex gloves.* Latex gloves should be durable even though they are to be worn under work gloves. All latex gloves should be properly disposed of prior to leaving the accident site.

*Work gloves.* Work gloves should be as durable as practical and provide the hand, wrist and forearm with puncture and abrasion protection. Leather, nitrile and kevlar gloves are commonly used. All three types should be disinfected or properly disposed of prior to leaving the accident site.

*Face masks.* Face masks should cover the nose and mouth. Masks come in disposable and reusable configurations and should be disinfected or properly disposed of prior to leaving the accident site.

*Protective goggles.* Protective goggles should enclose the eyes by sealing around the top, bottom and sides. Common safety glasses are not acceptable. Goggles should be fitted with one-way check valves or vents to prevent fogging and should be disinfected or properly disposed of prior to leaving the accident site.

*Disposable protective suits.* Protective suits should be durable and liquid-resistant and should fit properly. If possible, they should have elastic-type hoods and elastic pant cuffs. Duct tape can be used to alter the suits and to patch tears. Protective suits should be properly disposed of prior to leaving the accident site.

*Disposable shoe covers and protective boots.* Disposable shoe covers made of polyvinyl chloride (PVC) or butyl rubber are recommended. Leather, rubber or Gortex work boots are also acceptable. Disposable shoe covers and protective boots should be disinfected or properly disposed of prior to leaving the accident site.

*Disinfection chemicals.* Two chemical types are commonly used to disinfect personal protective equipment. Rubbing alcohol of 70 per cent strength is effective and is available in towelettes, as well as in large hand towels. The most effective disinfectant solution is a mixture of common household bleach and water, with one part bleach to ten parts of water. **Never mix alcohol and bleach.**

*Biological hazard disposal bags.* Biological hazard disposal bags must be used for disposal of contaminated personal protective equipment. The bags are red or orange and are labelled "Biological hazard". For transport, the disposed material should be double bagged.

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